

FINAL

Site Closure Report for Site ST71



**Elmendorf Air Force Base
Alaska**

Prepared For

**Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base
San Antonio, Texas**

and

**3 SPTG/CEVR
Elmendorf Air Force Base
Alaska**

November 1996

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**PARSONS
ENGINEERING SCIENCE, INC.**

1700 Broadway, Suite 900 • Denver, Colorado 80290

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Final

**SITE CLOSURE REPORT
FOR
SITE ST71
ELMENDORF AFB, ALASKA**

Prepared for:

**Air Force Center for Environmental Excellence
Brooks AFB, Texas
and**

**3 SPTG/CEVR
Elmendorf AFB, Alaska**

November 1996

**Parsons Engineering Science, Inc.
1700 Broadway, Suite 900
Denver, Colorado 80290**

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SECTION 1

INTRODUCTION

1.1 SCOPE AND OBJECTIVES

During the past 3 years, Elmendorf Air Force Base (AFB), Alaska has participated in the Air Force Bioventing Pilot Test Initiative project. Sponsored by the Air Force Center for Environmental Excellence (AFCEE) at Brooks AFB, Texas, the project has involved conducting more than 135 *in situ* bioventing pilot tests at 48 Air Force installations throughout the United States (US). These tests were designed to collect data on the effectiveness of bioventing for the remediation of soil contaminated with fuel hydrocarbons (e.g., JP-4 jet fuel, diesel fuel, gasoline, or heating oil).

Three-year-long bioventing pilot tests have recently been concluded at four fuel-contaminated Elmendorf AFB sites, including Site ST71 (Building 31-338), a former underground storage tank (UST) site. This closure report for Site ST71 has been prepared by Parsons Engineering Science, Inc. (Parsons ES) in keeping with the corrective action plan (CAP) for Site ST71 (US Air Force, 1995a) to support a "no further action" recommendation for vadose zone soils at Site ST71. This recommendation is based on analytical results obtained through implementation of a site-specific closure sampling and analysis plan (SAP) (Parsons ES, 1996). The closure SAP was reviewed and approved by Alaska Department of Environmental Conservation (ADEC) staff prior to implementation. A copy of the SAP is provided as Appendix A. The closure SAP presented a plan for confirmatory soil sampling and analysis to document the effectiveness of soil remediation at the site and to demonstrate compliance with regulatory requirements for closure of the vadose zone soils. Attainment of these regulatory cleanup standards, which are summarized in Table 1.1, signifies that the remediation of vadose zone soils through *in situ* bioventing has been completed, and that no further action is necessary. Using the matrix score sheet presented in Table 1.1, Site ST71 is considered a Category A site, and the Category A soil cleanup levels listed in Table 1.1 apply to the vadose zone soils.

Confirmation soil sampling was conducted after approximately 31 months of bioventing system operation. This soil sampling effort entailed drilling four boreholes to a depth of 13 to 15 feet below ground surface (bgs), and analyzing selected samples for fuel constituents to support site closure. A total of eight soil samples from the four boreholes were analyzed. All analytical results for vadose zone soil samples were below the ADEC Category A cleanup levels for benzene, toluene, ethylbenzene, and xylenes (BTEX), diesel-range organics (DRO), and gasoline-range organics (GRO). Based on these results, Parsons ES recommends that the Air Force request ADEC's concurrence on a no-further-action decision.

TABLE 1.1

**ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
MATRIX SCORE SHEET AND SOIL CLEANUP STANDARDS
AT SITE ST71**

1. Depth to Groundwater Less than 5 feet (10) 5 - 15 feet (8) 16 - 25 feet (6) 26 - 50 (4) More than 50 feet (1)	
2. Mean Annual Precipitation More than 40 inches (10) 26 - 40 inches (5) 16 - 25 (3) Less than 15 inches (1)	
3. Soil Type (Unified Soil Classification) Clean, coarse-grained soils (10) Coarse-grained soils with fines (8) Fine-grained soils (low organic carbon) (3) Fine-grained soils (high organic carbon) (1)	
4. Potential Receptors (Select the most applicable category) a. Public water system within 1000 feet, or private water system within 500 feet (15) b. Public/private water system within 1/2 mile (12) c. Public/private water system within one mile (8) d. No water system within one mile (4) e. Nonpotable groundwater (1)	
5. Volume of Contaminated Soil More than 500 cubic yards (10) 101 - 500 cubic yards (8) 26 - 100 cubic yards (5) 10 - 25 cubic yards (2) Less than 10 cubic yards (0)	

*The items to be scored are defined at 18 AAC 78.315(b).

Matrix Score for Each Category	Cleanup Level in mg/kg				
	Gasoline Range Organics	Diesel Range Organics	Residual Range Organics	Benzene	Total BTEX
Category A: More than 40	50	100	2000	0.1	10
Category B: 27-40	100	200	2000	0.5	15
Category C: 21-26	500	1000	2000	0.5	50
Category D: Less than 21	1000	2000	2000	0.5	100

1.2 REPORT ORGANIZATION

This site closure report consists of five sections, including this introduction, and four appendices. Section 2 includes a site description, history, and summary of previous investigations and remediation activities. Section 3 is a description of closure soil sampling activities that were conducted at the site. Section 4 contains a summary of closure sampling analytical results and a recommendation for site closure. References used in preparation of this study are provided in Section 5. Appendix A presents a copy of the closure SAP for Site ST71. Appendix B provides copies of site borehole logs, Appendix C presents laboratory analytical data for site environmental and quality assurance (QA) samples, and Appendix D presents the data quality control summary report.

SECTION 2

SITE DESCRIPTION AND HISTORY

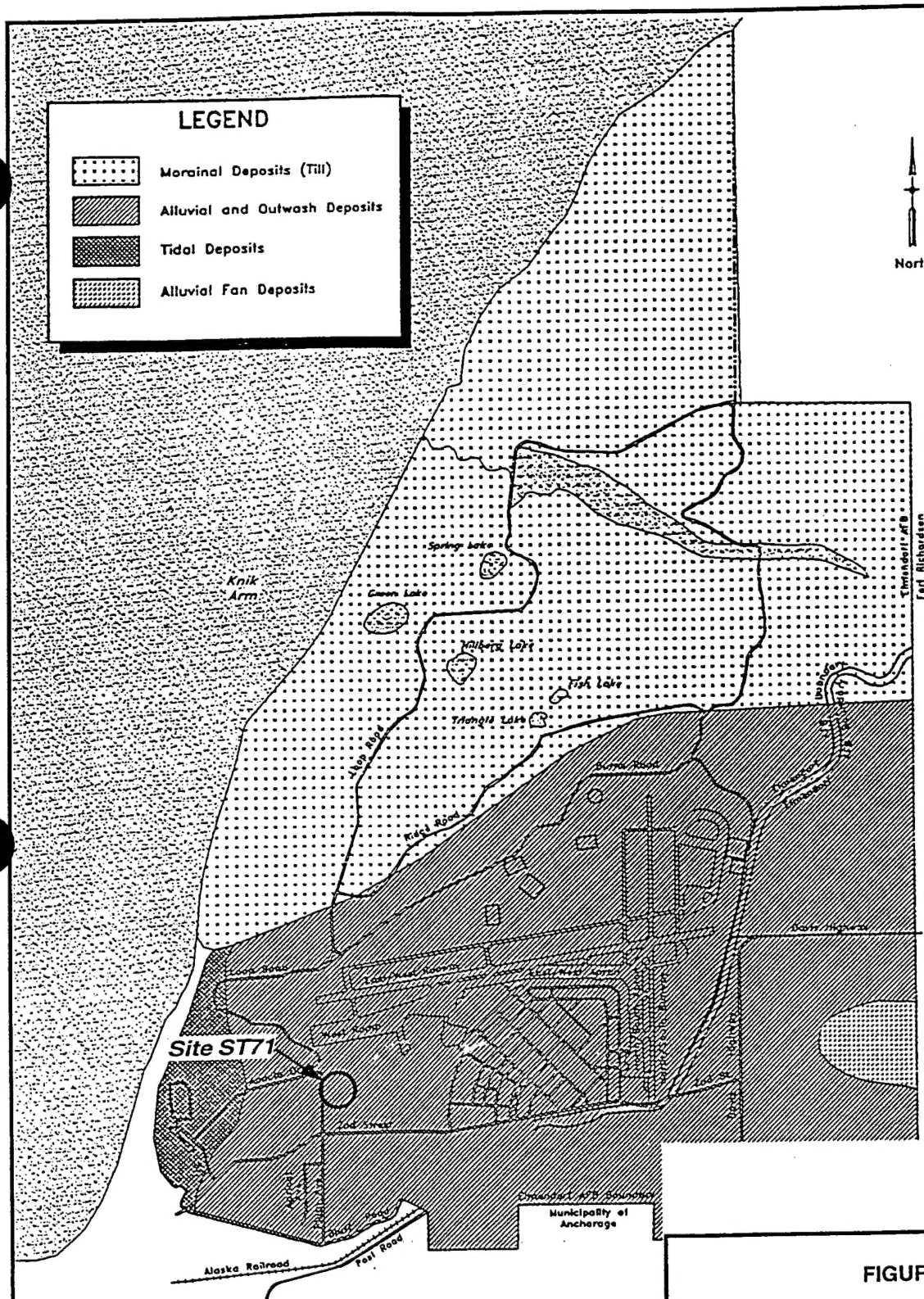
2.1 SITE ST71-FORMER UST SITE

Site ST71, currently the location of the Elmendorf AFB vehicle maintenance shop (Building 31-338), was the location of a former 500-gallon UST (tank 31-338) that was primarily used to store JP-4 jet fuel waste from fuel truck maintenance activities. Tank 31-338, which was located immediately north of Building 31-338, was gravity fed from waste fuel collection drains located inside the building. The site location relative to the Base is shown on Figure 2.1, and a detailed site map is shown on Figure 2.2. The area surrounding the building is gravel covered. It is unknown when the former 500-gallon UST was installed; however, aerial photographs indicate that the maintenance facility has been developed since the 1950's. The UST was removed in August 1992, and replaced with a 1,200-gallon UST (31-338A) in an adjacent location (US Air Force, 1994a). Historic operating information for the former tank is incomplete.

2.2 OVERVIEW OF GEOLOGY AND HYDROGEOLOGY

Elmendorf AFB lies within the Cook Inlet - Susitna Lowland physiographic province, referred to as the "Anchorage Lowland." The Anchorage Lowland is a large alluvial fan on the eastern shore of the Knik Arm of the Cook Inlet, surrounded by the Kenai, Chugach, and Talkeetna mountains. Local topography is generally flat, with a slight regional rise toward the east. Ship Creek flows along the southern boundary of the Base, approximately 2 miles south of Site ST71. There are no surface water bodies in the immediate vicinity of Site ST71; Site ST71 is approximately 1.5 miles east of Knik Arm (Figure 2.1).

Surficial deposits in the Elmendorf AFB area consist of Pleistocene glacial drift that was deposited during several glacial advances and retreats. During the most recent phase of glaciation, the ice reached a position overlying the current location of Elmendorf AFB. The ice advance temporarily stagnated, and poorly sorted sediment (till) was deposited at the ice front. Deposition of till produced a terminal moraine, called the Elmendorf Moraine. Site ST71 is located south of the Elmendorf Moraine, which is expressed topographically as a broad, northeast-to-southwest trending ridge. After the ice retreated, meltwaters moving away from the ice margin deposited sediment (mostly sand and gravel), producing a relatively flat, broad outwash plain upon which most of the Base facilities (including Site ST71) are located (Parsons ES, 1995a and 1995b). Figure 2.1 indicates the general distribution of shallow soil types at Elmendorf AFB.



E10702AA

FIGURE 2.1

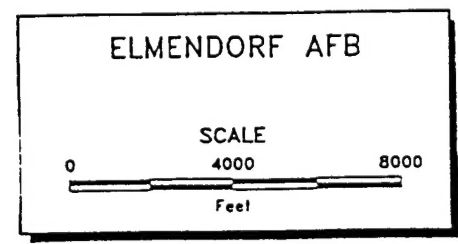
SITE LOCATION AND DISTRIBUTION OF SHALLOW SOIL TYPES

SITE ST71

Elmendorf Air Force Base, Alaska

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado



Sources: Radian, 1994.

49WL02

LEGEND

- ⊕ PARSONS ES VAPOR MONITORING POINT
- ▲ PARSONS ES BIOVENTING VENT WELL
- ENSR SOIL BORING
- ⊗ ENSR GROUNDWATER MONITORING WELL
- ← APPROXIMATE GROUNDWATER FLOW DIRECTION

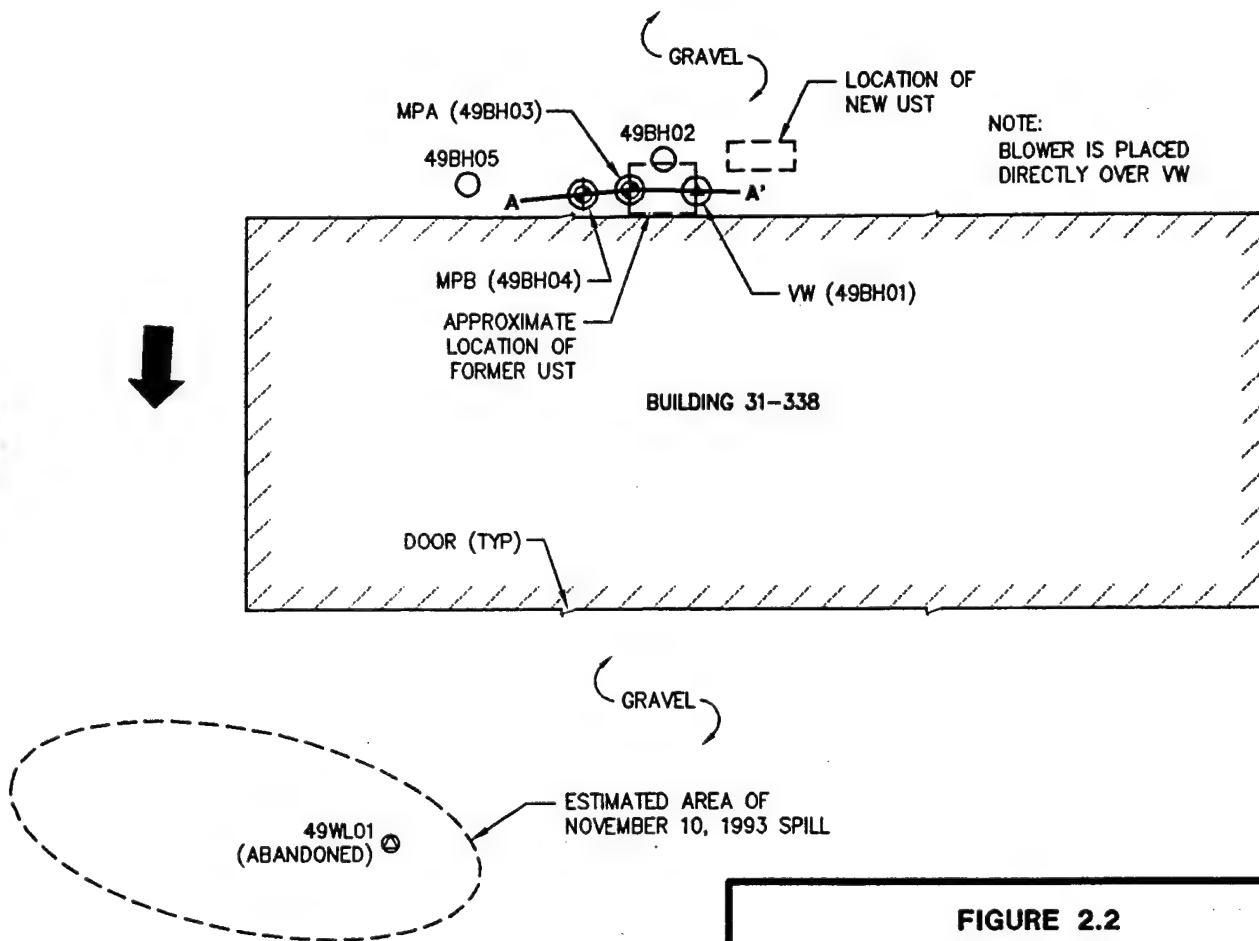


FIGURE 2.2

SITE LAYOUT SITE ST71

ELMENDORF AFB, ALASKA

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49WL01
(NEW)

0 20 40
SCALE: 1" = 40'

In general, two aquifers are present in the vicinity of Elmendorf AFB: 1) the shallow, unconfined aquifer (in either till or outwash deposits, depending on location), and 2) the deep, underlying confined aquifer, composed of sand and gravel outwash deposits, alluvial sand, and mixed deposits of glacial till. Between the shallow and deep aquifers is a regional aquitard known as the Bootlegger Cove Formation. This unit consists of interbedded silt and clay deposits and is approximately 50 feet thick. The upper portion of the Bootlegger Cove Formation is generally silty, while the lower unit is generally clayey (Parsons ES, 1994a and 1994b).

A hydraulic communication test between the shallow and deep aquifers, performed at Operable Unit 2 (OU2) in 1992, indicated that there is no apparent communication between the two aquifers (US Air Force, 1993). Basewide groundwater elevation data collected throughout 1993 indicates that flow in the shallow outwash aquifer is generally to the south and southwest, toward Ship Creek (US Air Force, 1994a). Water levels are highest in late spring, decreasing through the summer until fall, when rains cause another rise. This rise continues through late fall, and is followed by decreasing levels through the winter, until the spring thaw.

2.2.1 Site ST71 Geology

Subsurface soils at Site ST71 consist primarily of sand and gravel in varying proportions. Soils just above the groundwater table generally consist of gravely, medium- to coarse-grained sands. Figure 2.3 presents a hydrogeologic cross section for Site ST71. The location of the cross section trace is presented in Figure 2.2.

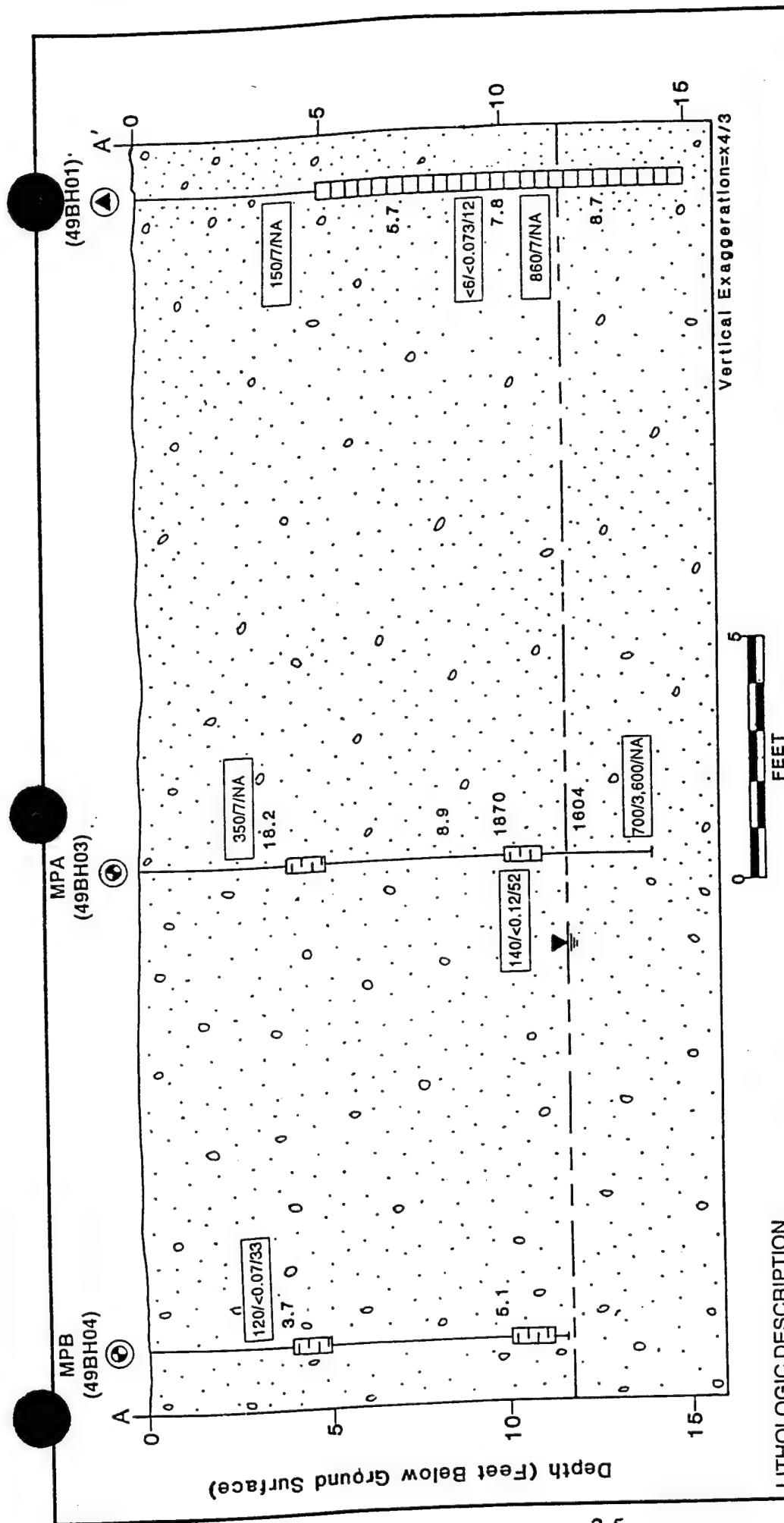
2.2.2 Site ST71 Hydrogeology

During the recent closure soil sampling field event, the depth to groundwater in well 49WL02, located approximately 170 feet north-northwest of the site, was measured at 9.02 feet bgs. The depth to groundwater in well 49WL01, located approximately 150 feet south-southwest of the site (Figure 2.2), was measured at 13.59 feet bgs. The depth to groundwater in the bioventing vent well (VW) was measured at 11.53 feet bgs. The horizontal hydraulic gradient at Site ST71 was approximated by a three-point analysis using water table elevations from wells 49WL01, 49WL02, and 48WL02 (located 1,500 feet southwest of Site ST71). Groundwater flow direction was determined to be to the south-southeast, with a gradient of approximately 0.017 foot per foot (ft/ft) (Air Force, 1995a).

2.3 PREVIOUS INVESTIGATIONS AT SITE ST71

2.3.1 UST Removal: 1992

The 500-gallon UST was removed in August 1992. A tank removal report referenced test borings installed during 1988 that indicated soil contamination (US Air Force, 1994b). A tank-tightness test conducted in 1990 indicated that the UST was not leaking; however, at the time of tank removal, soil contamination was noted. The soil contamination appeared to originate at the vent pipe, which was disconnected at the elbow. The vent pipe appeared to have been disconnected for a relatively long period



LITHOLOGIC DESCRIPTION

SAND AND GRAVEL

LEGEND

- MPA (49BH04) MONITORING POINT (ENSR SOIL BORING)
- VW (49BH03) VENT WELL (ENSR SOIL BORING)
- 1870 FIELD SCREENING RESULTS FOR TOTAL VOLATILE HYDROCARBONS (ppmv)
- 120/<0.07/33 LABORATORY RESULTS FOR SOIL DRO/GRO/TPH (mg/kg) JUNE 1993
- NA NOT ANALYZED
- GROUNDWATER ELEVATION
- GEOLOGIC CONTACT DASHED WHERE INFERRED
- SCREENED WELL INTERVAL

FIGURE 2.3

HYDROGEOLOGIC CROSS SECTION SITE ST71

Elmendorf AFB, Alaska



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Denver, Colorado

of time. Prior to backfilling the tank removal excavation, three soil samples were collected from the excavation for laboratory analysis. Analytical results indicated elevated total petroleum hydrocarbons (TPH) (analytical method unknown) and TEPH (method unknown) contamination. TPH results ranged from 6,890 to 14,400 milligrams per kilogram (mg/kg), and TEPH results ranged from 1,670 to 9,700 mg/kg for the three samples. The sample depths and depth to the bottom of the former tank are not known. No additional excavation or investigation work was performed at the time of tank removal (US Air Force, 1994b).

2.3.2 Site Investigation: 1993

Additional site characterization work was performed by ENSR in June and July 1993 (US Air Force, 1994b). Engineering Science, Inc. (ES) coordinated the 1993 AFCEE bioventing field program with the ENSR investigation to utilize several ENSR boreholes for vapor monitoring point (MP) and VW installation. At Site ST71, ES (1993) utilized three boreholes: one for the VW (49BH01) and two for monitoring points MPA (49BH03) and MPB (49BH04) (see Figure 2.2).

ENSR drilled and sampled five boreholes in and around the former UST excavation, and installed and sampled one upgradient groundwater monitoring well (49WL02) and one downgradient monitoring well (49WL01) for laboratory analysis of DRO [US Environmental Protection Agency (EPA) Method SW8100], GRO (EPA Method SW8015M), and BTEX (EPA Method SW8020). Results of the ENSR investigation are detailed in the February 1994 document entitled *SERA Phases 1A and 1B Site Assessment Report, Elmendorf Air Force Base* (US Air Force, 1994b). Table 2.1 summarizes the analytical data for site soil samples collected to date.

In addition to the ENSR samples, ES (1993) collected one soil sample from each of MPA (49BH03), MPB (49BH04), and the VW (49BH01) for laboratory analysis of DRO (EPA Method SW8015M), GRO (EPA Method SW8015M), total recoverable petroleum hydrocarbons (TRPH) (EPA Method 418.1), BTEX (EPA Method SW8020), and several physical soil characteristics (ES, 1993). Borehole, monitoring well, monitoring point, and VW locations are shown on Figure 2.2.

Figure 2.3 presents a hydrogeologic cross section that shows contaminant distribution with depth at 49BH01, 49BH03, and 49BH04. These boreholes were the locations of the highest concentrations of fuel hydrocarbons detected during the June 1993 investigation and bioventing system installation (ES, 1993). Samples collected from boreholes 49BH01 (VW) and 49BH03 (MPA), drilled through the former tank bed, had GRO and DRO concentrations above the ADEC (1995) Category A cleanup levels of 50 mg/kg and 100 mg/kg, respectively (Table 1.1). A sample collected from borehole 49BH03 (MPA) at a depth of 13 feet bgs had a DRO concentration of 700 mg/kg, a GRO concentration of 3,600 mg/kg, and a total BTEX concentration of 86.7 mg/kg (Table 2.1). Benzene concentrations were well below the Category A cleanup level of 0.1 mg/kg (US Air Force, 1994b; ES, 1993).

TABLE 2.1
PREVIOUS SOIL SAMPLE ANALYTICAL RESULTS
SITE ST71
ELMENDORF AFB, ALASKA

Location	Sample Depth (ft bgs) ^d	Date Sampled	Extractable Hydrocarbons (mg/kg)	Volatile Hydrocarbons (mg/kg)	E418.1 TRPH ^b (mg/kg)	EPA SW8020 BTEX (mg/kg) ^a			
						Benzene	Toluene	Ethylbenzene	Xylenes
49BH01 (Vent well)	3.5	6/16/93	150 ^d	7 ^e	NA ^f	<0.027	<0.027	<0.027	<0.027
49BH01 (Vent well)	11	6/16/93	860 ^d	7 ^e	NA	<0.027	0.073	<0.027	0.031
VW-10 (49BH01)	10	6/16/93	<6 ^d	<0.073 ^b	12	<0.0004	<0.0004	<0.0004	<0.0008
VW-10F (near 49BH01) ⁱ	10	8/8/94	<4.2 ^d	1.8 ^b	<5.2	<0.0005	0.0014	<0.0005	0.0009
49BH02	8	6/16/93	59 ^d	22 ^e	NA	0.033	0.14	0.033	0.12
49BH02	12.5	6/16/93	<11 ^d	<5 ^e	NA	<0.027	<0.027	<0.027	<0.027
49BH03 (MPA)	3.5	6/16/93	350 ^d	7 ^e	NA	<0.026	0.14	<0.026	0.12
49BH03 (MPA)	13	6/16/93	700 ^d	3600 ^e	NA	<0.53	1.3	4.9	80
MPA-10 (49BH03)	10	6/16/93	140 ^d	<0.12 ^b	52	<0.0004	<0.0004	<0.0004	<0.0008
MPA-10F (near 49BH03) ⁱ	10	8/8/94	<4.2 ^d	<0.11 ^b	74	<0.0005	<0.0005	<0.0005	<0.0007
MPB-4 (49BH04)	4	6/16/93	120 ^d	<0.07 ^b	33	<0.0004	<0.0004	<0.0004	<0.0008
MPB-4F (near MPB) ⁱ	4	8/8/94	<4.2 ^d	0.36 ^b	<5.3	<0.0005	0.0012	<0.0005	<0.0007
49BH05	8.5	7/20/93	<10 ^d	<5 ^e	NA	<0.026	0.063	<0.026	<0.026
49BH05	11	7/20/93	<10 ^d	<5 ^e	NA	<0.026	0.041	<0.026	0.12
49WL01	5.5	6/15/93	12 ^d	<5 ^e	NA	<0.026	<0.026	<0.026	<0.026
49WL01	10.5	6/15/93	<10 ^d	<5 ^e	NA	<0.026	0.051	<0.026	<0.026
49WL02	3.5	6/15/93	<10 ^d	<5 ^e	NA	<0.025	<0.025	<0.025	<0.025
49WL02	10.5	6/15/93	<11 ^d	<5 ^e	NA	<0.027	<0.027	<0.027	<0.027

Sources: ENSR, 1994; ES, 1993; US Air Force, 1995.

a/ BTEX = benzene, toluene, ethylbenzene, and xylenes; EPA = Environmental Protection Agency; mg/kg = milligrams per kilogram.

b/ TRPH = total recoverable petroleum hydrocarbons.

c/ ft bgs = feet below ground surface.

d/ Diesel-range organics (DRO) by Method 3510/8100 modified. This corresponds to carbon chain C10-C28.

e/ Gasoline-range organics (GRO) by Method 5030/8015 modified. This corresponds to carbon chain C6-C10.

f/ NA = Not analyzed.

g/ Total extractable petroleum hydrocarbons (TEPH) by Method SW8015. This corresponds to carbon chain C10-C28.

h/ Total volatile petroleum hydrocarbons (TVPH) by Method SW5030/8015. This corresponds to carbon chain C6-C10.

i/ Borehole located approximately 2 feet north of the original boring.

During the 1993 sampling event, a groundwater sample from downgradient monitoring well 49WL01 was found to be contaminated with all target analytes. DRO and GRO each were detected at concentrations of 9.7 milligrams per liter (mg/L), and total BTEX was detected at 2.2 mg/L. At upgradient monitoring well 49WL02, DRO was detected at a concentration of 0.78 mg/L, and GRO and BTEX were not detected (US Air Force, 1994b).

2.3.3 Bioventing: 1993-1996

During the 1993 ENSR investigation, ES (1993) installed a bioventing air injection VW and two vapor MPs (MPA and MPB) in boreholes 49BH01, 49BH03, and 49BH04, respectively. Figures 2.2 and 2.3, respectively, depict the locations of and hydrogeologic cross section for the VW and MPs completed at Site ST71. As described in the *Draft Bioventing Pilot Test Interim Results Report* (ES, 1993), initial soil gas testing at the VW and MP indicated naturally occurring biodegradation of fuel hydrocarbons was limited by depleted oxygen concentrations (<5 percent). Initial soil vapor testing indicated that contamination extended from directly beneath the former UST to approximately 12 feet bgs, at which depth groundwater was encountered. As part of the pilot test, an air permeability test and a respiration test were conducted at the former UST site. Air permeability testing indicated the VW's zone of pressure and oxygen influence included MPB, located approximately 23 feet east of the VW, and therefore, only one VW was required to provide oxygen to all contaminated vadose zone soils. The respiration test indicated hydrocarbon biodegradation rates of up to 840 mg of hydrocarbons per kg of soil per year (mg/kg/yr) at the 10-foot depth at MPB (MPB-10). Detailed pilot testing procedures and results are presented in the bioventing interim results report (ES, 1993). Long-term air injection at Site ST71 began in July 1993, and continued until April 30, 1996.

Year-end soil vapor sampling completed in August 1994 indicated a 99.8 percent and 98.1 percent reduction in total volatile hydrocarbons (TVH) (EPA method TO-3) in the two soil gas samples, and DRO reductions of 97 percent in each of the previously contaminated soil intervals (VW-10F, MPA-10F, and MPB-4F) (Table 2.2) (US Air Force, 1995b). After 1 year of bioventing, DRO soil concentrations decreased from 140 mg/kg to less than 4.2 mg/kg at MPA-10 (MPA-10F), and from 120 to less than 4.2 mg/kg at MPB-4 (MPB-4F) (Table 2.1). The blower was turned off for 30 days before sampling to allow soil gas to reach equilibrium. The year-end respiration tests indicated a hydrocarbon biodegradation rate of approximately 140 mg/kg/year. Table 2.3 presents the measured respiration and calculated biodegradation rates for Site ST71. During October 1995, a 2-year respiration test was conducted, the results of which indicated that the majority of the biodegradable fuel residuals had been destroyed, and that biodegradation of the remaining residuals was occurring at slow rates. The test indicated a biodegradation rate of approximately 90 mg/kg/year at MPB-10. Following the 2-year testing, the blower was restarted and operated until April 30, 1996. A 3-year respiration test conducted in May 1996, prior to closure soil sampling, indicated a biodegradation rate of approximately 45 mg/kg/year at MPB-10, signifying that respiration rates were approaching background rates.

TABLE 2.2
PREVIOUS SOIL GAS SAMPLE ANALYTICAL RESULTS
SITE ST71
ELMENDORF AFB, ALASKA

Location	Sample		TVH ^{c/}	Method TO-3 (ppmv) ^{a/}			
	Depth (ft bgs) ^{b/}	Date Sampled		Benzene	Toluene	Ethylbenzene	Xylenes
MPA-4	4	6/16/93	480	<0.049	<0.049	0.32	2.1
MPA-4	4	8/1/94	1	<0.002	0.003	<0.002	0.008
MPB-10	10	6/16/93	290	<0.012	<0.012	0.12	0.13
MPB-10	10	8/1/94	5.4	<0.002	0.005	0.063	0.058

Sources: ES, 1993; US Air Force, 1995.

a/ ppmv = parts per million, volume per volume.

b/ ft bgs = feet below ground surface.

c/ TVH = total volatile petroleum hydrocarbons.

TABLE 2.3
RESPIRATION AND DEGRADATION RATES
SITE ST71
ELMENDORF AFB, ALASKA

Location-Depth	Initial (July 1993)		6-Month ^{b/} (January 1994)		1-Year (August 1994)		2-Year ^{b/} (October 1995)		3-Year ^{b/} (May 1996)	
	K _o (% O ₂ /min)	Degradation Rate (mg/kg/year) ^{a/}	K _o (% O ₂ /min)	Degradation Rate (mg/kg/year)	K _o % O ₂ /min	Degradation Rate (mg/kg/year)	K _o (% O ₂ /min)	Degradation Rate (mg/kg/year)	K _o (% O ₂ /min)	Degradation Rate (mg/kg/year)
VW (5'-15')	0.00035	120	NS ^{c/}	NS	NS	NS	NS	NS	NS	NS
MPA-4	0.000086	30	NS	NS	NS	NS	NS	NS	NS	NS
MPA-10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MPB-4	0.00032	100	NS	NS	0.00049	140	0.00030	90	0.00006	20
MPB-10	0.0030	840	0.00025	70	0.0015	420	0.00033	90	0.00016	45

^{a/} Milligrams of hydrocarbons per kilogram of soil per year.

^{b/} Assumes moisture content of the soil is the average of initial and 1-year moistures.

^{c/} NS = Not Sampled.

2.3.4 Long-Term Groundwater Monitoring: 1993-1996

Additional groundwater monitoring has been performed since July 1993. Table 2.4 summarizes all site analytical data for groundwater samples collected to date. During the 1993 sampling event, a groundwater sample from downgradient monitoring well 49WL01 was found to be contaminated with DRO and GRO at concentrations of 9.7 mg/L, and with total BTEX at 2.2 mg/L. At upgradient monitoring well 49WL02, DRO was detected at a concentration of 0.78 mg/L, and GRO and BTEX were not detected (US Air Force, 1994b).

In September 1995, monitoring well 49WL01 was relocated further south because the well's integrity had been breached. Prior to abandonment, an estimated 100 gallons of JP-8 jet fuel was released just south of Building 31-338, near the original well (Figure 2.2). Following the spill, two 5-ton truck loads of contaminated soil were excavated and removed from the area (US Air Force, 1995a). Because the release occurred after the initial (July 1993) groundwater samples were collected, the impact of this release is not reflected in the initial results. Follow-up sampling of the relocated monitoring well was conducted in October 1995 (Mayer, 1995). Analytical results indicated increased levels of DRO (as jet fuel) (62.6 mg/L), ethylbenzene (113 micrograms per liter [$\mu\text{g/L}$]), and toluene (80.4 $\mu\text{g/L}$) contamination. However, total BTEX (1.5 mg/L) were lower in the further downgradient well than in the original well samples collected in 1993 (Mayer, 1995). The DRO increase is likely due to the recent fuel release, rather than to further groundwater degradation from the Site ST71 UST source soils.

As proposed in the CAP (US Air Force, 1995a), to monitor the progress of natural attenuation at the site, two groundwater sampling events since the JP-8 spill (October 1995 and May 1996) have been conducted to date. During each event, benzene was the only analyte detected above ADEC (1995) groundwater cleanup levels. Based on the analytical results for well 49WL01, it appears that dissolved BTEX are being naturally attenuated. Benzene, which was detected at concentrations of 42.5 $\mu\text{g/L}$ (October 1995) and 14.9 $\mu\text{g/L}$ (May 1996), is the only analyte that exceeded its ADEC groundwater cleanup level of 5 $\mu\text{g/L}$. Considering the rate at which benzene degraded over a 7-month period, it is anticipated that benzene concentrations will fall below the state cleanup level within 1 year.

Based on the geochemical trends and biodegradation rates observed at other sites in Alaska and other cold-climate environments, it is not surprising that the BTEX concentrations at well 49WL01 are decreasing significantly. Despite the cold groundwater environments of Alaska (typically below 10°C), estimated biodegradation rates for BTEX typically approach or exceed 1 percent per day (Herrington *et al.*, 1996). Two fuel-contaminated sites (Hanger 10 and Site ST41) at Elmendorf AFB were selected for intrinsic remediation studies as part of a nationwide demonstration project funded by the Air Force Center for Environmental Excellence (AFCEE). The project was developed to quantify and summarize the potential for natural attenuation processes, alone or as part of a broader risk-based approach, to remediate petroleum-contaminated sites at Air Force facilities. The treatability studies at Elmendorf AFB,

TABLE 2.4
PREVIOUS GROUNDWATER ANALYTICAL RESULTS
SITE ST71
ELMENDORF AFB, ALASKA

Location	Sample Date	Benzene (µg/L) ^{a/}	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Total BTEX (µg/L)	GRO (µg/L)	Unk. * Gasoline (µg/L)	Unk. ** Jet Fuel (µg/L)	DRO (µg/L)	Unk. *** Diesel (µg/L)
49WL01	07/16/93	740	35	95	1300	2170	9700	NA ^{b/}	NA	9.7	NA
49WL01 ^{c/}	10/05/95	42.5	80.4	113	1220	1455.9	8110	<54.3	62600	<2360	0.0
49WL01 ^{c/}		14.9	7.6	42	706	770.5	6850	<36.9	7610	<231	0.0
49WL02	07/16/93	<0.5	<0.5	<0.5	<0.5	<2.0	<100	NA	NA	0.78	NA
49WL02		0.424	1.99	4.47	8.99	15.874	<10.5	105	<238	<202	2070

* Unknown compounds within the gasoline range

Note: All compounds were analyzed using modified EPA Method SW8015M for diesel and gasoline range organics, and method SW8020 for BTEX.

** Unknown compounds within the jet fuel range

*** Unknown compounds within the diesel range

^{a/} µg/L = micrograms per liter.

^{b/} NA = Not analyzed.

^{c/} Relocated monitoring well.

conducted in June 1994 by Parsons ES and the EPA Robert S. Kerr Environmental Research Laboratory, concluded that natural biodegradation of dissolved petroleum hydrocarbons was not inhibited by the relatively cold water temperatures of Alaska (Parsons ES, 1995a and 1995b). Geochemical data suggested that microorganisms were biodegrading site contaminants through variable combinations of aerobic respiration, nitrate reduction, manganese reduction, iron reduction, sulfate reduction, and methanogenesis. At each Elmendorf AFB site, anaerobic biodegradation processes predominated.

As with a large number of biological processes, anaerobic biodegradation can generally be described using a first-order rate constant and the equation:

$$\frac{C}{C_0} = e^{-kt}$$

where:

C = Contaminant Concentration at Time t,

C₀ = Initial Contaminant Concentration,

k = Anaerobic Decay Coefficient (anaerobic rate constant),

and

t = time.

For Site ST71, assuming a first-order anaerobic decay rate of 0.0075 day⁻¹, which is an average of estimated anaerobic decay rates for Site ST41 (0.005 day⁻¹) and Hanger 10 site (0.01 day⁻¹) (Parsons ES, 1995a and 1995b), the BTEX half-life is approximately 100 days. To estimate the time required for the groundwater to meet the ADEC groundwater standards assuming biodegradation alone, the above equation is solved for "t". Solving for "t", benzene concentrations should theoretically decrease from a concentration of 14.9 µg/L to 5 µg/L in approximately 146 days, assuming that each BTEX compound is degraded at the same rate. The assumed decay rate is lower than decay constants frequently reported in literature (Table 2.5), and therefore is considered to be conservative. For example, Chapelle (1994) reported that at two different sites with anaerobic conditions, the anaerobic decay rate constants both were approximately 0.01 day⁻¹. Wilson *et al.* (1994) report first-order anaerobic biodegradation rates of 0.007 to 0.185 day⁻¹. Stauffer *et al.* (1994) report rate constants of 0.01 and 0.018 day⁻¹ for benzene and p-xylene, respectively.

TABLE 2.5
REPRESENTATIVE FIRST-ORDER ANAEROBIC DECAY RATE CONSTANTS
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

Reference	Decay Rate (day ⁻¹)
Chapelle (1994)	0.01 ^{a/}
Buscheck <i>et al.</i> (1993)	0.001 to 0.01 ^{a/}
Wiedemeier <i>et al.</i> (1995b)	0.01 to 0.03 ^{a/}
Wiedemeier <i>et al.</i> (1995b)	0.03 to 0.04 ^{b/}
Wiedemeier <i>et al.</i> (1995b)	0.02 to 0.04 ^{c/}
Wiedemeier <i>et al.</i> (1995b)	0.01 to 0.03 ^{d/}
Wiedemeier <i>et al.</i> (1995b)	0.006 to 0.03 ^{e/}
Stauffer <i>et al.</i> (1994)	0.01 ^{b/} to 0.02 ^{e/}
MacIntyre <i>et al.</i> (1993)	0.01 to 0.02 ^{e/}
MacIntyre <i>et al.</i> (1993)	0.007 to 0.012 ^{b/}
MacIntyre <i>et al.</i> (1993)	0.006 to 0.012 ^{f/}
Barker <i>et al.</i> (1987)	0.007 ^{b/}
Kemblowski <i>et al.</i> (1987)	0.0085 ^{b/}
Chiang <i>et al.</i> (1989)	0.095 ^{b/}
Wilson <i>et al.</i> (1990)	0.007 to 0.024 ^{b/}
Howard <i>et al.</i> (1991)	0.009 to 0.069 ^{b/}

a/ For total BTEX.

d/ For ethylbenzene.

b/ For benzene.

e/ For xylene.

c/ For toluene.

f/ For naphthalene.

SECTION 3

SITE CLOSURE SAMPLING AND ANALYSIS ACTIVITIES

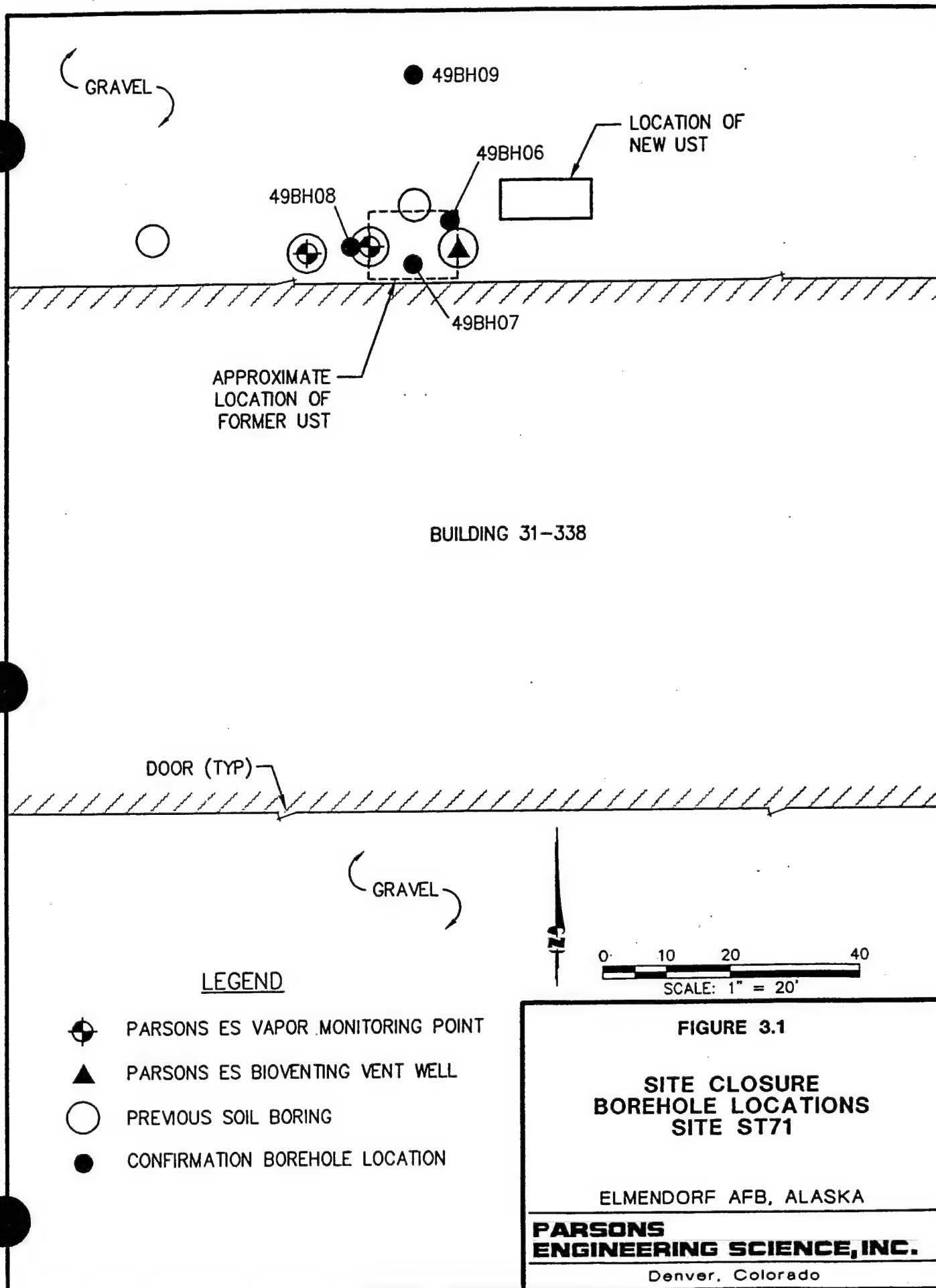
The purpose of this section is to describe site closure and soil sampling activities, including borehole locations and sampling depths, sampling procedures, analytical methods used, and QA/quality control (QC) procedures followed. These methods/procedures are described in the closure SAP for Site ST71 (see Appendix A). The closure SAP was implemented under the direct supervision of a qualified civil engineer.

3.1 SITE CLOSURE BOREHOLE LOCATIONS AND SAMPLING DEPTHS

Closure soil sampling was conducted at the site on May 28, 1996. To confirm that site contamination has been remediated to within acceptable levels, Parsons ES drilled and sampled three additional boreholes (49BH06, 49BH07, and 49BH08) within the former tank excavation, and one borehole upgradient from the site (49BH09). Confirmatory soils sampling borehole locations are shown on Figure 3.1. Samples for chemical analysis were collected at depths of 9.5 to 14.5 feet bgs. At boreholes 49BH06, 49BH07, and 49BH08 samples were collected continuously, from 3.5 feet bgs to at least 1 foot below groundwater depth, located at approximately 11.5 feet bgs. Field evidence of contamination (i.e., soil with above-background photoionization detector (PID) readings, petroleum odor, or discoloration) was observed in many of the samples; however, significant contamination (i.e., soil with PID readings greater than 20 parts per million, volume per volume [ppmv] above background) was observed only in the smear zone and saturated zone samples.

3.2 DRILLING, SAMPLING, AND EQUIPMENT DECONTAMINATION

Boreholes were advanced using a drill rig equipped with 8-inch outside-diameter (OD) hollow-stem augers. To minimize cuttings disposal costs, soil cuttings generated during drilling were temporarily placed in US Department of Transportation (DOT)-approved 55-gallon drums. Cuttings from above 10 feet bgs were containerized in one drum, and cuttings below 10 feet bgs were containerized in a separate drum. Following drilling activities, eight composite headspace samples were collected from the drum containing the deeper soils and analyzed using the PID. The PID reading for each sample was below 25 ppmv; therefore, drill cutting were spread thinly on the ground surface near the site, as proposed in the closure SAP.



Boreholes were logged by a Parsons ES engineer. Soil types were classified according to the Unified Soil Classification System (USCS) and described in accordance with the standard Parsons ES soil description format. These geologic borehole logs are presented in Appendix B.

Prior to arriving at the site, the drill rig, augers, drilling rods, bits, casing, samplers, tools, and other downhole equipment was decontaminated using a high-pressure, steam/hot water wash with laboratory-grade detergent, followed by a rinse with potable water. All sampling tools were decontaminated prior to use and between each use as described below:

- Scrub the equipment with a solution of hot potable water and Alconox® detergent. Rinse equipment with copious quantities of cold potable water followed by a reagent grade Type II water rinse.
- Rinse equipment with pesticide-grade methanol
- Air dry equipment on aluminum foil with shiny side down. All decontamination activities were conducted in a manner so that all excess water, and methanol were collected, containerized and deposited into the decontamination pad collection tanks.

Relatively undisturbed soil samples, suitable for chemical analysis, were collected at continuous intervals below 3.5 feet bgs at boreholes 49BH06, 49BH07, and BH08, and at continuous intervals below 9 feet bgs at 49BH09. Soil samples were collected in a 2.5-inch inside-diameter (ID) split-barrel sampler that was lowered through the hollow stem of the augers and driven approximately 2 feet into undisturbed soil, ahead of the augers.

The split-barrel sampler was fitted with four precleaned, 2.5-inch-OD by 6-inch-long, thin-walled, brass sleeves. Before samples were collected, sample sleeves were cleaned using the same procedure as that for the sampler. After collection of a sample, the sampler was retrieved, split apart, and the sleeves were removed. The ends of the middle sleeves that contain the samples for chemical analyses were covered with Teflon® sheets and plastic end caps.

Samples in the upper and/or lower sample sleeves were used for logging purposes, and were screened in the field for organic vapors using a PID. The data obtained from the logging and screening were recorded on the borehole logs (Appendix B).

The sleeves for chemical analysis were labeled with the site name and borehole number, sample depth, date of collection, and other pertinent data. These sleeves were immediately sealed in plastic bags and placed in an insulated shipping container with ice. The samples were maintained in a chilled condition until delivered to Quanterra Environmental Services, an Alaska state-approved laboratory located in Arvada, Colorado. Chain-of-custody records were prepared in the field in accordance with the SAP, and accompanied the samples to the analytical laboratory.

After pulling the augers out of the borehole, each borehole caved in. Therefore, bentonite was not used to abandon the boreholes. The VW and MPs at the site were left undisturbed and the blower system remains in place (though inactive). Should site closure be granted, Elmendorf AFB should make arrangements for the VW and MPs to be properly abandoned in accordance with Title 18 of the Alaska Administrative Code Part 80.015 (18 AAC 80.015) (ADEC, 1995).

3.3 FIELD AND LABORATORY DATA QUALITY ASSURANCE/QUALITY CONTROL

Four QA/QC samples were collected during field activities. The samples included a field duplicate, an equipment rinseate blank, and a trip blank. Also, additional sampling volume was submitted in order for the laboratory to run matrix spike/matrix spike duplicate (MS/MSD) analyses.

3.4 SOIL SAMPLE ANALYSIS

All samples were analyzed by Quanterra Environmental Services, a State of Alaska-approved and AFCEE-approved laboratory. The sample analytical methods and practical quantitation limits (PQLs) used during this effort are presented in Table D1.1 (Appendix D). All soil samples were analyzed by EPA Method SW8015A modified for DRO, EPA Method SW8015A modified GRO, and EPA Method SW8020A for BTEX.

3.5 DATA VALIDATION

Laboratory data were subjected to a data validation process as described in Appendix D. Based on this process, data used to support a closure recommendation meet the project data quality objectives.

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the analytical results from the field sampling conducted pursuant to closure of Site ST71 at Elmendorf AFB. Based on earlier site investigations and bioventing pilot testing, and on the results of the closure sample analyses, conclusions regarding remediation of fuel contaminants in vadose zone soils are summarized, and recommendations for Site ST71 are presented.

4.1 LABORATORY RESULTS

Complete laboratory analytical results from Quanterra Environmental Services are presented in Appendix C and summarized in Table 4.1. A total of 10 confirmatory soil samples for laboratory analysis of DRO, GRO, and BTEX, including a field duplicate and an MS/MSD sample, were collected from Site ST71. One vadose zone and one smear zone sample was collected from each of source area borings 49BH06, 49BH07, and 49BH08. Three smear zone soil samples (including a MS/MSD sample) were collected from upgradient boring 49BH09. Results indicate that two of the source area borings in saturated soil contain residual DRO and/or GRO concentrations above ADEC Category A cleanup levels. A saturated soil sample collected from boring 49BH07 at a depth of 12 feet bgs contained 930 mg/kg of DRO and 1,600 mg/kg of GRO, and a saturated sample collected from boring 49BH08 at a depth of 13 feet bgs contained 500 mg/kg of DRO and 30 mg/kg of GRO. The two saturated soil samples collected from upgradient boring 49BH09 both contained DRO, GRO, and BTEX concentrations below cleanup levels. All vadose zone soil samples contained DRO and GRO concentrations that were below the ADEC (1995) Category A cleanup levels listed on Table 1.1. All confirmation soil samples contained BTEX concentrations below cleanup levels. BTEX results provided in Table 4.1 are Quanterra Laboratory's "preferred result" of the primary and secondary column analytical results (Appendix C).

4.2 CONCLUSIONS

There was some field evidence of fuel hydrocarbon contamination (i.e., soil with above-background PID readings, petroleum odor, or discoloration) in all of the samples collected from source area soil borings (49BH06, 49BH07, and 49BH08). Based on the presence of groundwater contamination at this site, the ADEC Category A cleanup levels, listed in Table 1.1, apply. All of the laboratory analytical results for vadose zone soils were below ADEC (1995) Category A soil cleanup levels for all analytical

TABLE 4.1
CONFIRMATION SOIL SAMPLE ANALYTICAL RESULTS - MAY 28, 1996
SITE ST71
ELMENDORF AFB, ALASKA

Sample ID	Sample Depth (ft bgs) ^{a/}	Matrix	USEPA Method					
			SW8015A M Mod. Diesel (mg/kg) ^{b/}	SW8015A M Mod. Gasoline (mg/kg)	Benzene (µg/kg) ^{d/}	Toluene (µg/kg)	Ethylbenzene (µg/kg)	Xylenes (µg/kg)
49BH06-9.5	9.5	Soil	50	32	<5.2 ^{u/}	3.8	1.0	3.8
49BH06-11.5	11.5	Soil	37	22	<5.4	1.5	1.5	5.7
49BH06-21.5 ^{a/}	12	Soil	23	2.7	<5.5	<5.5	0.96	1.5
49BH07-10.5	10.5	Soil	24	3.3	<5.2	2.3	2.6	9.4
49BH07-12	12	Sat. Soil ^{f/}	930	1,600	<540	<540	<540	2,100
49BH08-11.5	11.5	Soil	12	0.84	1.3	3.2	1.1	3.3
49BH08-13	13	Sat. Soil	500	30	<5.6	<5.6	32	<5.6
49BH09-13 ^{a/}	13	Sat. Soil	3.4	0.69	<5.1	<5.1	<5.1	<5.1
49BH09-14.5	14.5	Sat. Soil	<4.2	0.39	<5.3	<5.3	<5.3	2.1
Trip Blank	NA ^{j/}	Water	(mg/L) ^{v/} ---		(µg/L) ^{v/} <0.50	(µg/L) 0.16	(µg/L) <0.50	(µg/L) <0.50
Rinseate Blank	NA	Water	<0.10	---	---	---	---	---
Field Blank	NA	Water	---	---	<0.50	0.064	<0.50	<0.50

a/ ft bgs = feet below ground surface.

b/ mg/kg = milligrams per kilogram.

c/ µg/kg = micrograms per kilogram.

d/ Analyte not detected at the reporting limit.

e/ Duplicate of 49BH06-11.5 sample.

f/ Saturated soil sample.

g/ Matrix spike/Matrix spike duplicate (MS/MSD) also run on this sample.

h/ mg/L = milligrams per liter.

i/ µg/L = micrograms per liter.

j/ NA = Not applicable.

k/ --- = Not analyzed.

methods. These results indicate that petroleum hydrocarbons in the vadose zone soils at the site have been remediated to the applicable matrix cleanup levels during the operation of the bioventing system. Only soil samples from within the smear zone or below the watertable were found to contain elevated concentrations of petroleum compounds. Contaminated soil below the watertable is not effectively remediated through bioventing.

4.3 RECOMMENDATIONS

Based on the site closure soil sample analytical results summarized in Table 4.1, site closure with no further remedial action at the site is recommended. With the exception of benzene concentrations in groundwater at downgradient well 49WL01 (14.9 µg/L), and GRO (930 mg/kg at 49BH07-12, and 500 mg/kg at 49BH08-13) and DRO (1,600 mg/kg at 49BH07-12) concentrations in saturated soil samples, this site meets all applicable state cleanup goals. Therefore, it is requested that ADEC approve closure of vadose zone soils at Site ST71. Per the CAP, remediation of site groundwater should proceed via natural chemical attenuation processes. The effectiveness of this approach to remediate dissolved benzene to concentrations below the state groundwater action level of 5 µg/L will be verified via long-term groundwater monitoring (US Air Force, 1995a). Once closure of vadose zone soils at Site ST71 has been granted, it is recommended that the bioventing system be dismantled and removed from the site, and that Elmendorf AFB make arrangements for the VW and MPs to be properly abandoned in accordance with 18 AAC 80.015 (ADEC, 1995). It also is recommended that long-term monitoring of groundwater at 49WL01 continue under the basewide groundwater monitoring program until two consecutive analytical data sets indicate that all target analytes are below ADEC groundwater cleanup criteria. Should future sampling results from monitoring well 49WL01 indicate a contaminant increase, then additional investigation should be considered to determine whether or not additional sources are present near the site.

Analytical results from the recent closure soil sampling event provide sufficient evidence to support closure of Site ST71. Source area vadose zone soils have been remediated to below ADEC Category A cleanup levels, and dissolved BTEX concentrations in groundwater appear to be attenuating naturally. Therefore, based on successful source removal using active remediation (bioventing) for soils and apparent intrinsic remediation of groundwater, no further remedial action beyond continued long-term groundwater monitoring is recommended. The US Air Force will continue to implement institutional controls, and the current land use dictates that no subsurface disturbance will occur at this site in the foreseeable future. Current Base policy does not allow the extraction of shallow groundwater for potable uses. Therefore, contaminated groundwater will not be used by onsite receptors. Until monitoring indicates that no fuel constituents are present at levels of regulatory concern, any possible future lease or development of the area will contain use restrictions to prevent groundwater pumping, to protect existing groundwater wells to the extent possible, and to minimize contact with contaminated soils.

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APPENDIX A

**CLOSURE SAMPLING AND ANALYSIS PLAN FOR SITE ST71
ELMENDORF AFB, ALASKA**

FINAL

**Closure Sampling and
Analysis Plan for Site ST71**



**Elmendorf Air Force Base
Alaska**

Prepared For

**Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base
San Antonio, Texas**

and

**3 SPTG/CEVR
Elmendorf Air Force Base
Alaska**

April 1996



**PARSONS
ENGINEERING SCIENCE, INC.**

1700 Broadway, Suite 900 • Denver, Colorado 80290

FINAL

**CLOSURE SAMPLING AND ANALYSIS PLAN
FOR
SITE ST71
ELMENDORF AFB, ALASKA**

Prepared for:

**Air Force Center for Environmental Excellence
Brooks AFB, Texas
and**

**3 SPTG/CEVR
Elmendorf AFB, Alaska**

April 1996

**Parsons Engineering Science, Inc.
1700 Broadway, Suite 900
Denver, Colorado 80290**

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SECTION 1

INTRODUCTION

This site closure sampling and analysis plan (SAP) has been prepared by Parsons Engineering Science, Inc. (Parsons ES) for submittal to the Alaska Department of Environmental Compliance (ADEC). The SAP describes soil sampling and analyses to confirm that soils at Site ST71 at Elmendorf Air Force Base (AFB), Alaska meet regulatory requirements for closure. The ADEC is responsible for oversight of investigation, remediation, and closure of underground storage tank (UST) sites in Alaska. In addition to this SAP, the standard sampling procedures presented in Chapter 2 of the ADEC (1995) *Underground Storage Tanks Procedures Manual* will be adhered to.

During the past 2.5 years, Elmendorf AFB (the Base) has participated in the Air Force Bioventing Pilot Test Initiative Project. Sponsored by the Air Force Center for Environmental Excellence (AFCEE) at Brooks AFB, Texas, the project included conducting more than 135 *in situ* bioventing pilot tests at 48 Air Force installations throughout the country. These tests were designed to collect data on the effectiveness of bioventing for the remediation of soil contaminated with fuel hydrocarbons (i.e., JP-4 jet fuel, diesel fuel, gasoline, heating oil, etc.). Two-year-long bioventing pilot tests were concluded at four Elmendorf AFB sites in October 1995. Based on the results of these 2-year tests, it appears that *in situ* bioventing has been effective enough to support closure of Site ST71 soils at Elmendorf AFB. This SAP presents a plan for confirmation soil sampling to document the effectiveness of soil remediation at this site and to demonstrate compliance with regulatory requirements for site closure for soils. As proposed in the Site ST71 Corrective Action Plan (ENSR Consulting and Engineering [ENSR], 1995), groundwater contamination at the site will be addressed under a separate corrective action that includes Operable Unit 5 (OU5). Therefore, groundwater contamination is not addressed in this closure plan.

This SAP consists of nine sections, including this introduction, and one appendix. Section 2 includes a site description, history, and summary of previous investigations and remediation activities. Section 3 summarizes all applicable site closure requirements. A detailed site closure SAP is presented in Section 4. Analytical results will be presented in a site closure report as described in Section 5. Section 6 includes a proposed project schedule. Section 7 provides the project points of contact. Section 8 provides references cited in this SAP. Appendix A presents a copy of the project organizational chart and the Qualified Personnel Forms for Parsons ES personnel who will conduct soil sampling under this SAP.

SECTION 2

SITE DESCRIPTION AND HISTORY

Elmendorf AFB is located immediately north of Anchorage, Alaska, west of the Chugach Mountain Front. In the immediate vicinity of the Base are other petroleum-based industries, light to medium manufacturing/industrial facilities, and single-family homes to the south and southeast of the Base.

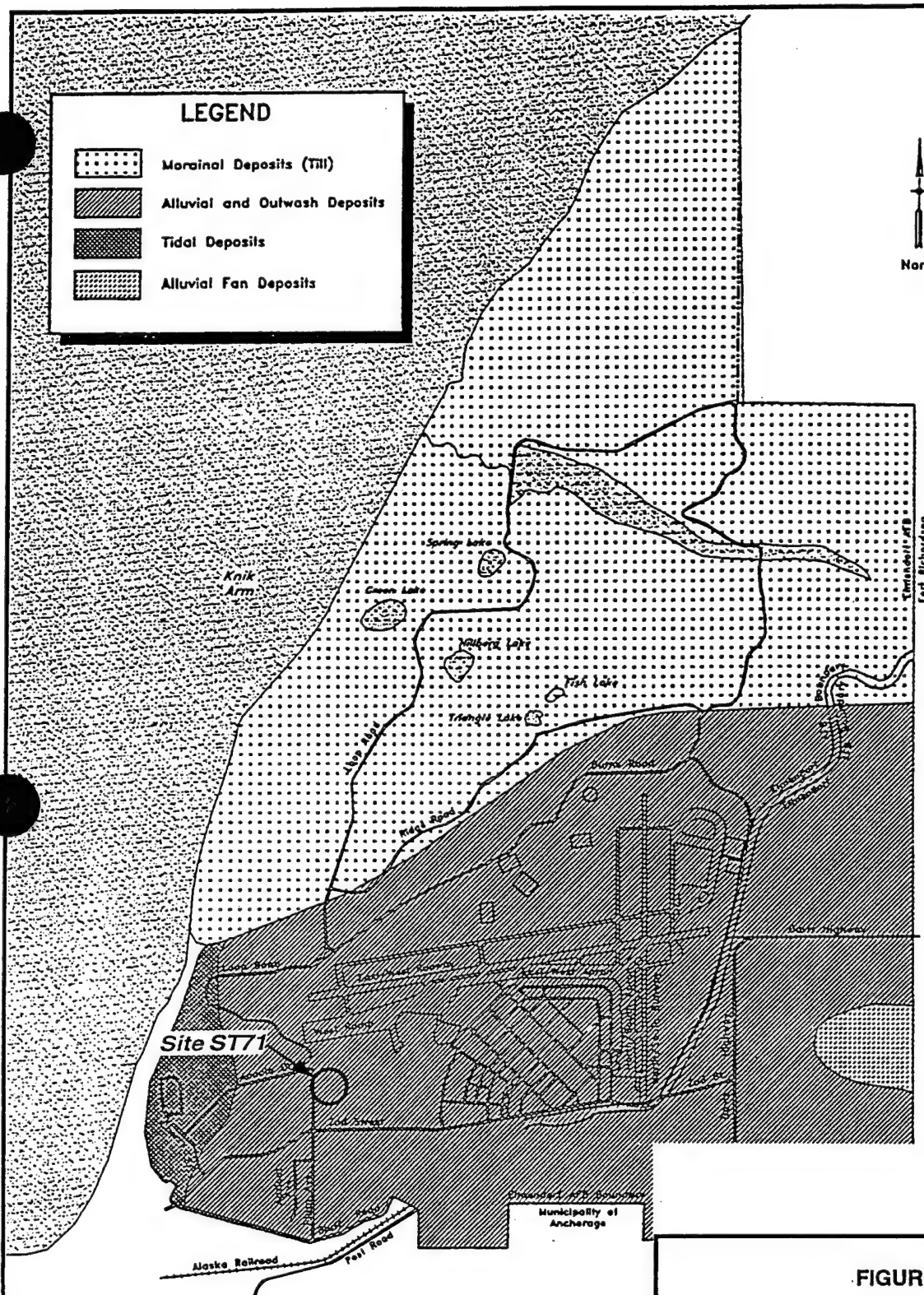
Fort Richardson is currently located east of Elmendorf AFB, however, prior to 1951, Fort Richardson encompassed what is now known as Elmendorf AFB. Elmendorf AFB is under the command of Headquarters PACAF for the US Air Force. On-Base facilities include office buildings, hangers, some warehouse and maintenance shops, and a Base exchange center. The Base has two runways and aircraft-related facilities.

2.1 SITE ST71-FORMER UST SITE

Site ST71, currently the location of the vehicle maintenance shop (Building 31-338), was the location of a former 500-gallon UST (31-338) that was used to store primarily JP-4 jet fuel waste from fuel truck maintenance activities. Tank 31-338, located immediately north of Building 31-338, was gravity fed from waste fuel collection drains located inside the building. The site location relative to the Base is shown on Figure 2.1, and a detailed site map is shown on Figure 2.2. The area surrounding the building is gravel covered. It is unknown when the former 500-gallon UST was installed; however, aerial photographs indicate that the maintenance facility has been developed since the 1950's. The UST was removed in August 1992, and replaced with a 1,200-gallon UST (31-338A) in an adjacent location (ENSR, 1994). Historic information for the tank is incomplete.

2.2 OVERVIEW OF GEOLOGY AND HYDROGEOLOGY

Elmendorf AFB lies within the Cook Inlet - Susitna Lowland physiographic province, referred to as the "Anchorage Lowland." The Anchorage Lowland is a large alluvial fan on the eastern shore of the Knik Arm of the Cook Inlet, surrounded by the Kenai, Chugach, and Talkeetna mountains. Local topography is generally flat, with a slight regional rise toward the east. Ship Creek flows along the southern boundary of the Base, approximately 2 miles south of Site ST71. There are no surface water bodies in the immediate vicinity of Site ST71; Site ST71 is approximately 1.5 miles east of Knik Arm.



E10702AA

(Modified from CH2M Hill, 1992)

ELMENDORF AFB

SCALE

0 4000 8000

Feet

Sources: Radian, 1994.

FIGURE 2.1

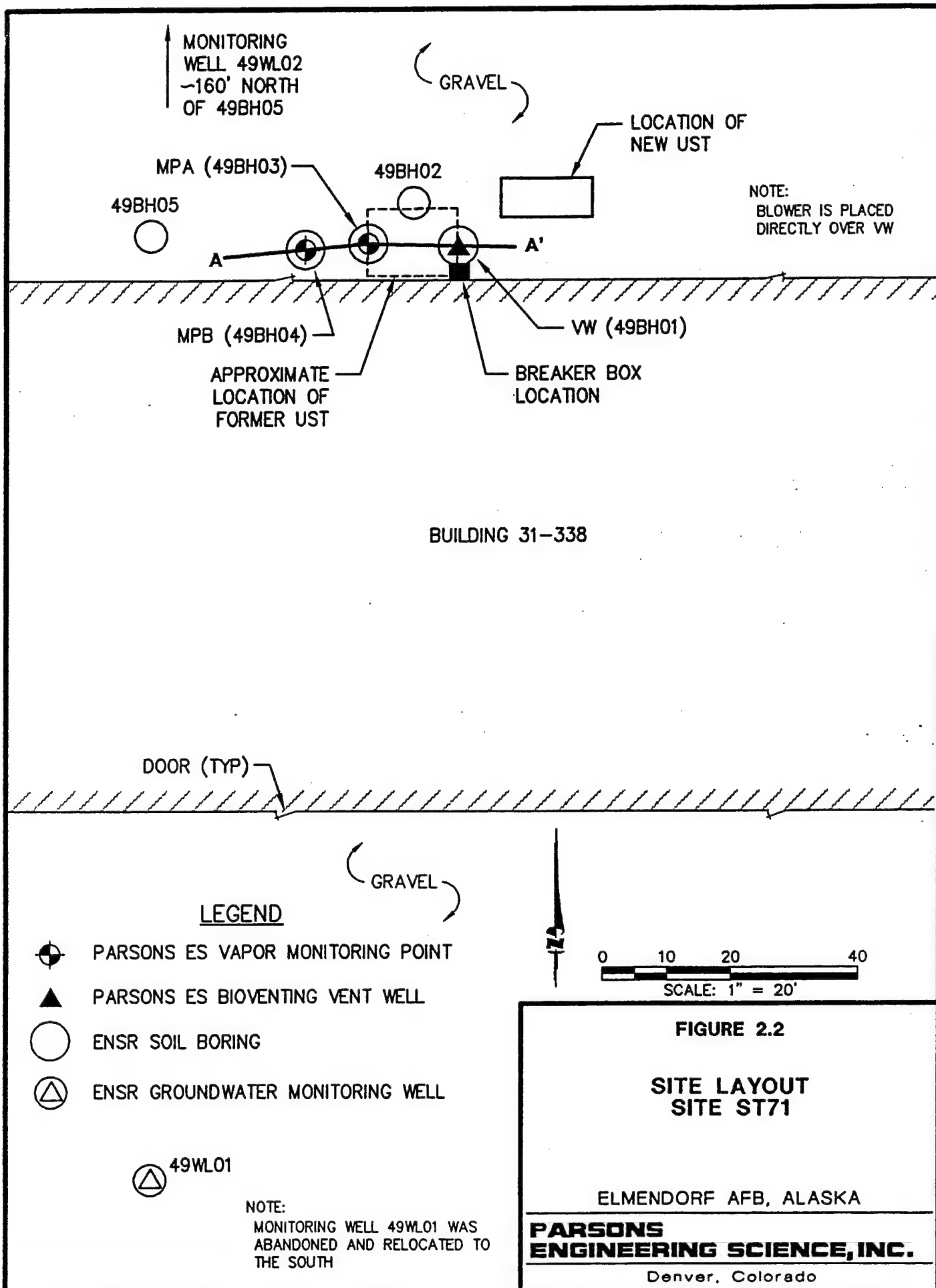
SITE LOCATION AND DISTRIBUTION OF SHALLOW SOIL TYPES

SITE ST71

Elmendorf Air Force Base, Alaska

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado



Surficial deposits in the Elmendorf AFB area consist of Pleistocene glacial drift that was deposited during several glacial advances and retreats. During the most recent phase of glaciation, the ice reached a position overlying the current location of Elmendorf AFB. The ice advance temporarily stagnated, and poorly sorted sediment (till) was deposited at the ice front. Deposition of till produced a terminal moraine, called the Elmendorf Moraine. Site ST71 is located south of the Elmendorf Moraine, which is expressed topographically as a broad, northeast-to-southwest trending ridge. After the ice retreated, meltwaters moving away from the ice margin deposited sediment (mostly sand and gravel), producing a relatively flat, broad outwash plain upon which most of the Base facilities (including Site ST71) are located (Engineering-Science, Inc. [ES], 1994). Figure 2.1 indicates the general distribution of shallow soil types at Elmendorf AFB.

In general, two aquifers are present in the vicinity of Elmendorf AFB. In order of increasing depth, these aquifers are 1) the shallow aquifer (in either till or outwash deposits, depending on location); and 2) the deep confined aquifer, comprised of sand and gravel outwash deposits, alluvial sand, and mixed deposits of glacial till. Between the shallow and deep aquifers is a regional aquitard known as the Bootlegger Cove Formation. This unit consists of interbedded silt and clay deposits and is approximately 50 feet thick. The upper portion of the Bootlegger Cove Formation is generally silty, while the lower unit is generally clayey (ES, 1994).

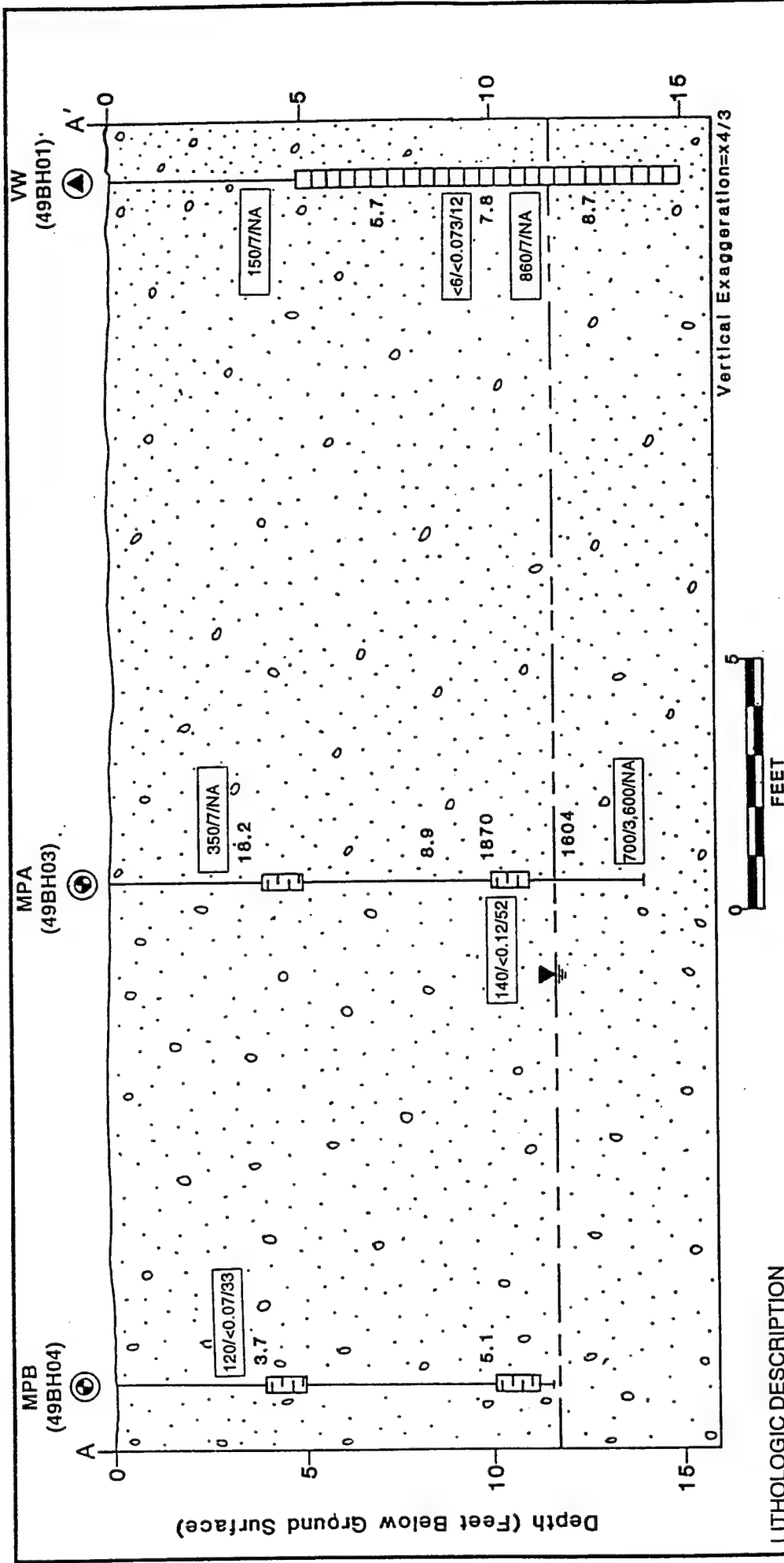
A hydraulic communication test between the shallow and deep aquifers, performed in OU2 in 1992, indicated that there is apparently no communication between the two aquifers (Jacobs Engineering Group [Jacobs], 1993).. Basewide groundwater elevation data collected throughout 1993 indicates that flow in the shallow outwash aquifer is generally to the south and southwest, toward Ship Creek (Jacobs, 1994). Water levels are highest in late spring, decreasing through the summer until fall, when rains cause another rise. This rise continues through late fall, and is followed by decreasing levels through the winter, until the spring thaw.

2.2.1 Site ST71 Geology

Subsurface soils at Site ST71 primarily consist of sand and gravel in varying proportions. Soils just above the groundwater table generally consist of gravely, medium- to coarse-grained sands. Figure 2.3 presents a hydrogeologic cross section for Site ST71.

2.2.2 Site ST71 Hydrogeology

The depth to groundwater in well 49WL02, located approximately 170 feet north-northwest of the site, was measured at 9.18 feet below ground surface (bgs) on June 16, 1995. The depth to groundwater in well 49WL01, located approximately 150 feet south-southwest of the site (Figure 2.2), was measured at 13.75 feet bgs on September 26, 1995. The horizontal hydraulic gradient at Site ST71 was approximated by a three-point analysis using water table elevations from wells 49WL01, 49WL02, and 48WL02. These three wells will be located and sounded during closure sampling activities (see Section 4). Groundwater flow direction was determined to be to the



LITHOLOGIC DESCRIPTION

SAND AND GRAVEL

LEGEND

- MONITORING POINT (ENSR SOIL BORING)
- VENT WELL (ENSR SOIL BORING)
- FIELD SCREENING RESULTS FOR TOTAL VOLATILE HYDROCARBONS (ppmv)
- LABORATORY RESULTS FOR SOIL DRO/GRO/TPH (mg/kg) JUNE 1993
- NOT ANALYZED
- -- GROUNDWATER ELEVATION
- GEOLGIC CONTACT DASHED WHERE INFERRER
- MONITORING POINT SCREENED INTERVAL
- SCREENED WELL INTERVAL

FIGURE 2.3

HYDROGEOLOGIC CROSS SECTION SITE ST71

Elmendorf AFB, Alaska

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

south-southeast, with a gradient of approximately 0.017 foot per foot (ft/ft) (ENSR, 1995). Based on observations made during the bioventing installation, groundwater at the former tank site is expected to be located approximately 11 to 12 feet bgs. The updated groundwater depth data will be included in the site closure report.

2.3 PREVIOUS INVESTIGATIONS AT SITE ST71

2.3.1 UST Removal: 1992

The 500-gallon UST was removed in August 1992. A tank removal report referenced test borings installed during 1988 that indicated soil contamination (ENSR, 1994). A tank-tightness test conducted in 1990 indicated that the UST was not leaking; however, at the time of tank removal, soil contamination was noted. The soil contamination appeared to originate at the vent pipe, which was disconnected at the elbow. The vent pipe appeared to have been disconnected for a relatively long period of time. Prior to backfilling, three soil samples were collected from the excavation for laboratory analysis. Analytical results indicated elevated total petroleum hydrocarbons (TPH) (analytical method unknown) and total extractable petroleum hydrocarbons (TEPH) (method unknown) contamination. TPH results ranged from 6,890 to 14,400 milligrams per kilogram (mg/kg), and TEPH results ranged from 1,670 to 9,700 mg/kg for the three samples. The sample depths and depth to the bottom of the former tank are unknown. No additional excavation or investigation work was performed at the time of tank removal (ENSR, 1994).

2.3.2 Site Investigation: 1993

Additional site characterization work was performed by ENSR in June 1993. ES coordinated the 1993 AFCEE bioventing field program schedule with the ENSR investigation to utilize several ENSR boreholes for vapor monitoring point (MP) and vent well (VW) installation. At Site ST71, Parsons ES utilized three boreholes; one for the vent well (49BH01) and two for monitoring points MPA (49BH03) and MPB (49BH04) (see Figure 2.3).

ENSR (1994) drilled and sampled five boreholes in and around the former UST excavation, and installed and sampled one upgradient (49WL02) and one downgradient (49WL01) groundwater monitoring well for laboratory analysis of diesel-range organics (DRO), gasoline-range organics (GRO), and benzene, toluene, ethylbenzene, and xylenes (BTEX). Results of the investigation are detailed in the February 1994 document entitled *SERA Phases 1A and 1B Site Assessment Report, Elmendorf Air Force Base*. Table 2.1 summarizes all site analytical data for soil samples collected to date. In addition to the ENSR samples, ES (1993) collected one soil sample from each of MPA (49BH03), MPB (49BH04), and the vent well (49BH01) for laboratory analysis of TEPH, total volatile petroleum hydrocarbons (TVPH), total recoverable petroleum hydrocarbons (TRPH), BTEX, and several physical soil characteristics. Borehole, monitoring well, monitoring point, and vent well locations are shown on Figure 2.2.

Figure 2.3 presents a hydrogeologic cross section that shows contaminant distribution with depth at 49BH01, 49BH03, and 49BH04. These boreholes were the

TABLE 2.1
SOIL SAMPLE ANALYTICAL RESULTS
SITE ST71
ELMENDORF AFB, ALASKA

Location	Sample Depth (ft bgs) ^d	Date Sampled	Extractable Hydrocarbons (mg/kg)	Volatile Hydrocarbons (mg/kg)	E418.1 TRPH ^h (mg/kg)	EPA SW8020 BTEX (mg/kg) ^a			
						Benzene	Toluene	Ethylbenzene	Xylenes
49BH01 (Vent well)	3.5	6/16/93	150 ^d	7 ^d	NA ^f	<0.027	<0.027	<0.027	<0.027
49BH01 (Vent well)	11	6/16/93	860 ^d	7 ^d	NA	<0.027	0.073	<0.027	0.031
VW-10 (49BH01)	10	6/16/93	<6 ^d	<0.073 ^h	12	<0.0004	<0.0004	<0.0004	<0.0008
VW-10F (near 49BH01) ⁱ	10	8/8/94	<4.2 ^d	1.8 ^h	<5.2	<0.0005	0.0014	<0.0005	0.0009
49BH02	8	6/16/93	59 ^d	22 ^d	NA	0.033	0.14	0.033	0.12
49BH02	12.5	6/16/93	<11 ^d	<5 ^d	NA	<0.027	<0.027	<0.027	<0.027
49BH03 (MPA)	3.5	6/16/93	350 ^d	7 ^d	NA	<0.026	0.14	<0.026	0.12
49BH03 (MPA)	13	6/16/93	700 ^d	3600 ^h	NA	<0.53	1.3	4.9	80
MPA-10 (49BH03)	10	6/16/93	140 ^d	<0.12 ^h	52	<0.0004	<0.0004	<0.0004	<0.0008
MPA-10F (near 49BH03) ⁱ	10	8/8/94	<4.2 ^d	<0.11 ^h	74	<0.0005	<0.0005	<0.0005	<0.0007
MPB-4 (49BH04)	4	6/16/93	120 ^d	<0.07 ^h	33	<0.0004	<0.0004	<0.0004	<0.0008
MPB-4F (near MPB) ⁱ	4	8/8/94	<4.2 ^d	0.36 ^h	<5.3	<0.0005	0.0012	<0.0005	<0.0007
49BH05	8.5	7/20/93	<10 ^d	<5 ^d	NA	<0.026	0.063	<0.026	<0.026
49BH05	11	7/20/93	<10 ^d	<5 ^d	NA	<0.026	0.041	<0.026	0.12
49WL01	5.5	6/15/93	12 ^d	<5 ^d	NA	<0.026	<0.026	<0.026	<0.026
49WL01	10.5	6/15/93	<10 ^d	<5 ^d	NA	<0.026	0.051	<0.026	<0.026
49WL02	3.5	6/15/93	<10 ^d	<5 ^d	NA	<0.025	<0.025	<0.025	<0.025
49WL02	10.5	6/15/93	<11 ^d	<5 ^d	NA	<0.027	<0.027	<0.027	<0.027

Sources: ENSR, 1994; ES, 1993; US Air Force, 1995.

a/ BTEX = benzene, toluene, ethylbenzene, and xylenes; EPA = Environmental Protection Agency; mg/kg = milligrams per kilogram.

b/ TRPH = total recoverable petroleum hydrocarbons.

c/ ft bgs = feet below ground surface.

d/ Diesel-range organics (DRO) by Method 3510/8100 modified. This corresponds to carbon chain: C10-C28.

e/ Gasoline-range organics (GRO) by Method 5030/8015 modified. This corresponds to carbon chain: C6-C10.

f/ NA = Not analyzed.

g/ Total extractable petroleum hydrocarbons (TEPH) by Method SW8015. This corresponds to carbon chain: C10-C28.

h/ Total volatile petroleum hydrocarbons (TVPH) by Method SW5030/8015. This corresponds to carbon chain: C6-C10.

i/ Borehole located approximately 2 feet north of the original boring.

locations of the highest concentrations of fuel hydrocarbons detected during the June 1993 ENSR investigation. Samples collected from boreholes 49BH01 (vent well) and 49BH03 (MPA), drilled through the former tank bed, had GRO and DRO concentrations above the ADEC (1995b) Level B cleanup levels of 100 mg/kg and 200 mg/kg, respectively. A sample collected from borehole 49BH03 (MPA) at a depth of 13 feet bgs had a DRO concentration of 700 mg/kg, a GRO concentration of 3,600 mg/kg, and a total BTEX concentration of 86.7 mg/kg (Table 2.1). Benzene concentrations were well below the most stringent action level of 0.5 mg/kg (ENSR, 1994).

During the 1993 sampling event, a groundwater sample from downgradient monitoring well 49WL01 was found to be contaminated with all target analytes. DRO and GRO were each detected at concentrations of 9.7 milligrams per liter (mg/L), and detected total BTEX was 2.2 mg/L. At upgradient monitoring well 49WL02, DRO was detected at a concentration of 0.78 mg/L, while GRO and BTEX were not detected (Radian, 1993). In September 1995, monitoring well 49WL01 was relocated further south because the well's integrity was breached. Prior to abandonment, an estimated 100 gallons of JP-8 jet fuel was released near the well. Because the release occurred after groundwater samples were collected, the impact of the release is not reflected in the initial results. Follow-up sampling of the relocated monitoring well was conducted by ENSR in October 1995. Analytical results indicated increased levels of TEPH (as jet fuel) (62.6 mg/L), ethylbenzene (113 micrograms per liter [$\mu\text{g/L}$]), and toluene (80.4 $\mu\text{g/L}$) contamination. However, total BTEX (1.5 mg/L) were lower in the further downgradient well (Mayer, 1995). The TEPH increase is likely due to the recent fuel release, rather than to further groundwater degradation from the Site ST71 UST source soils.

2.3.3 Bioventing: 1993-1996

During the 1993 ENSR investigation, ES installed a bioventing air injection vent well (VW) and two vapor monitoring points (MPA and MPB) in boreholes 49BH01, 49BH03, and 49BH04, respectively. Figures 2.2 and 2.3, respectively, depict the locations of and hydrogeologic cross-section for the VW and MPs completed at Site ST71. As described in the *Draft Bioventing Pilot Test Interim Results Report* (ES, 1993), initial soil gas testing at the VW and MP indicated naturally occurring biodegradation was limited by depleted oxygen concentrations (<5 percent). Initial soil vapor testing indicated that site contamination extended from directly beneath the former UST to approximately 12 feet bgs, at which depth groundwater was encountered. As part of the pilot test, an air permeability test and a respiration test were conducted at the former UST site. Air permeability testing indicated the VW's zone of pressure and oxygen influence included MPB, located approximately 23 feet east of the VW, and therefore, only one VW was required to provide oxygen to all contaminated vadose zone soils. The respiration test indicated hydrocarbon biodegradation rates of up to 840 mg of hydrocarbons per kg of soil per year (mg/kg/yr) at MPB-10. Detailed pilot testing procedures and results are presented in the bioventing interim results report (ES, 1993). Long-term air injection at Site ST71 began in July 1993, and will continue until 29 April 1996.

TABLE 2.2
SOIL GAS SAMPLE ANALYTICAL RESULTS
SITE ST71
ELMENDORF AFB, ALASKA

Location	Sample Depth (ft bgs) ^{b/}	Date Sampled	TVH ^{c/}	Method TO-3 (ppmv) ^{a/}			
				Benzene	Toluene	Ethylbenzene	Xylenes
MPA-4	4	6/16/93	480	<0.049	<0.049	0.32	2.1
MPA-4	4	8/1/94	1	<0.002	0.003	<0.002	0.008
MPB-10	10	6/16/93	290	<0.012	<0.012	0.12	0.13
MPB-10	10	8/1/94	5.4	<0.002	0.005	0.063	0.058

Sources: ES, 1993; US Air Force, 1995.

a/ ppmv = parts per million, volume per volume.

b/ ft bgs = feet below ground surface.

c/ TVH = total volatile petroleum hydrocarbons.

Year-end soil vapor sampling completed in August 1994 indicated a 99.8 percent and 98.1 percent reduction in total volatile hydrocarbons (TVH) in the two soil gas samples, and DRO reductions of 97 percent in both of the previously contaminated soil intervals (Table 2.2). The blower was turned off for 30 days before sampling to allow soil gas to reach equilibrium. The year-end respiration tests indicated a hydrocarbon biodegradation rate of approximately 140 mg/kg/year. During October 1995, a 2-year respiration test was conducted, indicating that the majority of the biodegradable fuel residuals have been destroyed, and that biodegradation of the remaining residuals is occurring at slow rates. The test indicated a biodegradation rate of approximately 92 mg/kg/year at MPB-10. Following the 2-year testing, the blower was restarted and is currently injecting air into the VW. Based on the encouraging year-end soil and soil gas sampling and testing results, and the 2-year respiration testing, it is anticipated that site DRO and GRO concentrations are below 100 mg/kg and 50 mg/kg, respectively, and that BTEX concentrations are below detection limits. Because of the relatively low DRO, GRO and BTEX concentrations detected in soil after 1 year of bioventing at the former UST site, and the added benefit of 2 additional years of bioventing system operation by the time closure soil sampling is performed, it is expected that the former UST site has been remediated to within regulatory cleanup levels. After 1 year of bioventing, DRO soil concentrations decreased from 140 mg/kg to less than 4.2 mg/kg at MPA-10 (MPA-10F), and from 120 to less than 4.2 mg/kg at MPB-4 (MPB-4F) (Table 2.1). Therefore, it is anticipated that the results of the site closure soil sampling described in Section 4 will indicate that required source removal has been achieved and will support no further soil remediation at the site.

SECTION 3

SITE CLOSURE REQUIREMENTS

In November 1995, the ADEC (1995b) published its UST regulations in Title 18 Alaska Administrative Code Part 78 (18 AAC 78), *Underground Storage Tanks*. Site assessment, corrective action, and cleanup regulations are provided. These regulations set specific numerical cleanup goals based on type of contaminant, depth to groundwater, soil type, volume of contaminated soil, and potential potable use of groundwater (e.g., as drinking water). In September 1995, the ADEC (1995a) released *Underground Storage Tanks Procedures Manual*. This guidance manual provides standard sampling procedures and guidance for remediation of petroleum-contaminated soil and water, including quality control procedures and data quality objectives for closure sampling. The standard sampling procedures in this manual will be adhered to during the closure soil sampling and reporting, unless otherwise noted.

3.1 SITE CHARACTERIZATION REQUIREMENTS

When performing a permanent UST closure, as required by 18 AAC 78.090, the owner must complete a site characterization, and depending on the results of the site characterization, perform a site assessment (under 18 AAC 78.220) or a release investigation. At Site ST71, a site characterization was performed during tank removal activities in 1992, and a subsequent site assessment was performed the following year (ENSR, 1994) after confirmation of soil contamination at the site. The results of the site investigation are presented in the *SERA Phases 1A and 1B Site Assessment Report* (ENSR, 1994). Immediately following the site assessment, a bioventing system was installed to bioremediate petroleum contamination in source-area vadose zone soils. A formal Corrective Action Plan (CAP) was submitted in April 1995, as required by 18 AAC 78.250, and approved in May 1995 (ENSR, 1995).

The CAP indicated that in November 1993, a release of an estimated 100 gallons of JP-8 fuel occurred in the gravel parking lot south of Building 31-338. Following the spill, two 5-ton truck loads of contaminated soil were excavated and removed from the area. In September 1994, monitoring well 49WL01, which was located near the spill, was abandoned and relocated further south of the original location. A subsequent groundwater sample from the new monitoring well indicated an increase in DRO, ethylbenzene, and toluene contaminants, in comparison to the previous sample from the original monitoring well. Because of the recent fuel release downgradient from Site ST71 and upgradient from the relocated monitoring well 49WL01, groundwater contamination increases at monitoring well 49WL01 cannot be clearly related to further groundwater degradation by Site ST71 soils. Rather, should closure soil sampling results exceed cleanup levels, a contaminant leachate model will be performed to

determine the potential future impact of Site ST71 vadose zone soil contamination on groundwater quality.

3.2 STATE SOIL CLEANUP STANDARDS

Soil cleanup standards for petroleum-impacted sites, presented in 18 AAC 78.315 of the UST guidance, are summarized in Table 3.1. Based on the "Matrix Score Sheet" (Table 3.1), as defined in 18 AAC 78.315(b), Level B cleanup levels would apply to Site ST71. However, considering that groundwater at the site has been impacted by petroleum leachate from site soils, Level A cleanup levels apply to Site ST71, as defined in 18 AAC 78.315(I).

3.3 GROUNDWATER

As discussed previously, groundwater contamination in the vicinity of Site ST71 is being addressed under a separate remediation program for OU5. Therefore, groundwater will not be addressed during the site closure sampling activities.

TABLE 3.1

**ALASKA DEPARTMENT OF ENVIRONMENTAL COMPLIANCE
MATRIX SCORE SHEET AND SOIL CLEANUP STANDARDS
AT SITE ST71**

1. Depth to Groundwater Less than 5 feet 5 - 15 feet (10) 16 - 25 feet (8) 26 - 50 (6) More than 50 feet (4) (1)	
2. Mean Annual Precipitation More than 40 inches (10) 26 - 40 inches (5) 16 - 25 (3) Less than 15 inches (1)	
3. Soil Type (Unified Soil Classification) Clean, coarse-grained soils (10) Coarse-grained soils with fines (8) Fine-grained soils (low organic carbon) (3) Fine-grained soils (high organic carbon) (1)	
4. Potential Receptors (Select the most applicable category) a. Public water system within 1000 feet, or private water system within 500 feet (15) b. Public/private water system within 1/2 mile (12) c. Public/private water system within one mile (8) d. No water system within one mile (4) e. Nonpotable groundwater (1)	
5. Volume of Contaminated Soil More than 500 cubic yards (10) 101 - 500 cubic yards (8) 26 - 100 cubic yards (5) 10 - 25 cubic yards (2) Less than 10 cubic yards (0)	

*The items to be scored are defined at 18 AAC 78.315(b).

Matrix Score for Each Category	Cleanup Level in mg/kg				
	Gasoline Range Organics	Diesel Range Organics	Residual Range Organics	Benzene	Total BTEX
Category A: More than 40	50	100	2000	0.1	10
Category B: 27-40	100	200	2000	0.5	15
Category C: 21-26	500	1000	2000	0.5	50
Category D: Less than 21	1000	2000	2000	0.5	100

SECTION 4

SITE CLOSURE SAMPLING AND ANALYSIS PLAN

The following site-specific SAP describes the borehole locations and sampling depths, soil sampling procedures, and analytical methods proposed to collect sufficient data to support closure of Site ST71 soils. This plan has been prepared and will be implemented or supervised by a qualified person as required by 18 AAC 78. The Qualified Personnel Form for each Parsons ES employee that will perform the sampling is presented in Appendix A.

4.1 DRILLING, SAMPLING, AND EQUIPMENT DECONTAMINATION

This subsection addresses the procedures for drilling and soil sampling. All soil sampling will be conducted in accordance with the procedures outlined in *Underground Storage Tanks Procedures Manual* (ADEC, 1995b).

4.1.1 Pre-Drilling Activities

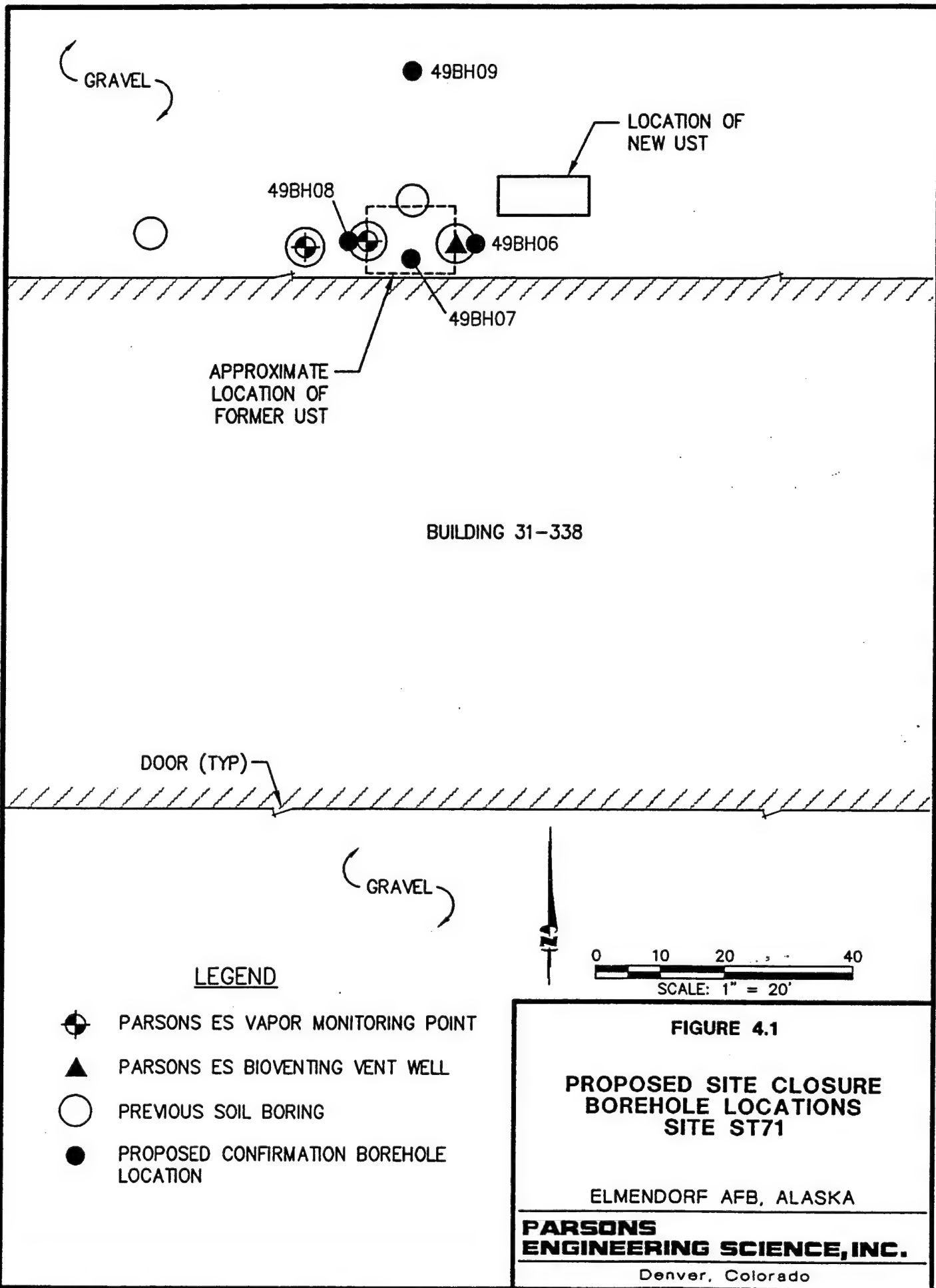
All necessary digging and drilling permits will be obtained prior to drilling activities. In addition, all utility lines will be located and proposed drilling locations cleared prior to any drilling activities.

Water to be used in drilling, equipment cleaning, or grouting will be obtained from one of the base's on-site water supplies. Water use approval will be verified by contacting the appropriate facility personnel. Only potable water will be used for the activities listed above. The field engineer will make the final determination as to the suitability of site water for these activities.

4.1.2 Site Closure Borehole Locations and Sampling Depths

To confirm that the extent of site contamination has been adequately characterized and remediated to within acceptable levels, Parsons ES proposes to drill and sample four boreholes. Proposed and previous borehole locations are shown on Figure 4.1. An upgradient borehole (49BH09) will be installed to determine if upgradient sources are impacting soils at Site ST71. The three other locations were chosen based on the extent of soil contamination observed during the June 1993 site investigation (ENSR, 1994).

To determine whether or not "smear zone" contamination is present, the three boreholes (49BH06, 49BH07, and 49BH08) near Building 31-338 will be drilled to approximately 1 foot below the groundwater surface. Samples will be collected continuously, from 3.5 feet bgs to 1 foot below groundwater depth, anticipated to be



approximately 12 feet bgs (see Figure 2.3). One "smear zone" soil sample, collected from each of these three boreholes will be sent to the laboratory for analysis. To determine the impact of upgradient sources, two "smear zone" soil samples will be collected from borehole 49BH09, to be located north of the former UST location. Samples from borehole 49BH09 will be collected continuously from 8 to 12 feet bgs.

Selection of the vadose zone samples for laboratory analysis will be based on field screening results. Samples with field evidence of contamination (e.g., odor, staining, or above-background photoionization detector [PID] and total hydrocarbon vapor analyzer [THVA] readings) will be preferentially retained for laboratory analysis. The background PID reading will be measured in the breathing zone, at least 50 feet from the drill rig. To confirm non-detect field screening results, at least one vadose zone soil sample from each of the three UST area boreholes (49BH06, 49BH07, and 49BH08) will be retained for laboratory analysis. Soil samples will be collected and analyzed as described in Subsections 4.2 and 4.3, respectively. A total of nine soil samples (including one duplicate sample) will be analyzed for DRO, GRO, and BTEX. In the unlikely event that analytical results indicate additional site remediation is required, the VW and MPs will not be abandoned, and the bioventing system operation will continue. Should site closure be granted, Elmendorf AFB will make arrangements to properly abandon the VW and MPs.

4.1.3 Drilling and Soil Sampling

Drilling in unconsolidated soils will be accomplished using the hollow-stem auger method with 6-inch outside-diameter (OD) augers. Borings will be drilled and continuously sampled from 3.5 feet bgs to approximately 1 foot below the groundwater surface. Boreholes will be logged by a Parsons ES engineer.

Continuous soil samples will be obtained using a CME[®] split-barrel continuous sampling device. Relatively undisturbed soil samples, suitable for chemical analysis, will be collected continuously over the full proposed depth of the soil borehole. Soil samples will be collected in a 2.5-inch inside-diameter (ID) split-barrel sampler that will be lowered through the hollow stem of the augers and driven approximately 1.5 foot, into undisturbed soil, ahead of the augers.

The split-sampler will be fitted with three precleaned, 2.5-inch OD by 6-inch-long, thin-walled, brass sleeves. Before samples are collected, sample sleeves will be cleaned using the same procedure as that for the sampler. After collection of a sample, the sampler will be retrieved, split apart, and the sleeves will be removed. The ends of the lowest sleeve that contains the sample for chemical analysis will be covered with Teflon sheets and plastic end caps.

The upper sample sleeves will be used for logging purposes, and will be screened in the field for organic vapors using a PID and a TVHA. Representative portions of the soil samples collected for the headspace procedure will be quickly transferred to the containers, which will be sealed and held for 15 minutes at an ambient temperature of 65 degrees Fahrenheit (°F) or greater. Semiquantitative measurements will be made by puncturing the container seal with the PID probe and reading the concentration of the headspace gases. The PID relates the concentration of total VOCs in the sample to an

isobutylene calibration standard. It is anticipated that headspace measurements will be performed on all samples collected during the drilling operations. The PID will also be used to monitor the workers breathing zone. The data obtained from the logging and screening will be recorded on the borehole logs.

The sleeves for chemical analysis will be labeled with the site name and borehole number, sample depth, date of collection, project name, and other pertinent data. These sleeves will be placed immediately in an insulated shipping container with ice, and will be maintained in a chilled condition (ideally 4° Celsius) until delivered to the analytical laboratory. Table 4.1 details the types of sample containers, sample volumes, methods of preservation, and holding times for each sample matrix by analytical method. Chain-of-custody records will be prepared in the field and will accompany the samples to the analytical laboratory.

The Parsons ES site manager will be responsible for observing all drilling activities, maintaining a detailed descriptive log of subsurface materials recovered, photographing representative samples, and properly labeling and storing samples. An example of the proposed geologic boring log form is presented in Figure 4.2. The descriptive log will contain:

- Sample interval (top and bottom depth);
- Sample recovery;
- Presence or absence of contamination;
- Soil or rock description, including: relative density, color, major textural constituents, minor constituents, relative moisture content, grain size, structure or stratification, and any other significant observations; and
- Lithologic contacts: the depth of lithologic contacts and/or significant textural changes will be measured and recorded to the nearest 0.1 foot.

4.1.4 Decontamination Procedures and Investigation Derived Waste Handling

Prior to arriving at the site, the drill rig, augers, drilling rods, bits, casing, samplers, tools and other downhole equipment will be decontaminated using a high-pressure, steam/hot water wash with Alconox or equivalent laboratory-grade detergent. If necessary, the equipment will be scrubbed until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The inside surfaces of casings, drill rods, and auger flights will also be washed as described above. Lastly, the equipment will be rinsed with copious amounts of cold potable water.

During drilling operations, the drill rig, augers, and any downhole drilling and/or sampling equipment will be decontaminated at the Elmendorf AFB decontamination pad or another location specified by base personnel. Water from the decontamination operations will be run through the conditioning unit, then allowed to collect in the decontamination pad collection tanks. Precautions will be taken to minimize any impact to the area surrounding the decontamination pad that might result from the

TAMU 1
SAMPLE CONTAINERS, SAMPLE PRESERVATION METHODS, AND
HOLDING TIMES FOR SOIL
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

Analytical Parameter	Analytical Method	Sample Containers		Preservation Method (Chill at 4°C)	Holding Time
		Quantity	Type		
Total Volatile Hydrocarbons (TVH) (Gasoline)	SW5030/SW8015AM ^{b/}	1	4 oz wide mouth with Teflon-lined cap or brass tube	4°C	14 days
Total Extractable Hydrocarbons (TEH) (Diesel)	SW3510/SW8015AM ^{b/}	1	4 oz wide mouth with Teflon-lined cap or brass tube	4°C	14 days
Volatile Aromatic Compounds (BTEx)	SW8020A	1	4 oz glass jar with Teflon-lined cap or brass tube	4°C minimize headspace	14 days

^{a/} All handling procedures are in accordance with the following references: Test Methods for Evaluating Solid Waste (EPA SW-846, September 1987) and Standard Methods for the Examination of Water and Wastewater (APHA, AWWA, WPCF; 17th Edition, 1989).

^{b/} The TEH method is EPA method SW3550/SW8015 modified. The TVH method is EPA method SW5030/SW8015 modified.

Figure 4.2

Sheet 1 of 1

GEOLOGIC BORING LOG

JOB NUMBER.: 726876.41122 CLIENT: AFCEE/Elmendorf AFB DATE: _____
 BORING NUMBER: _____ BORING DIA.: _____ ELEVATION: _____
 RIG TYPE: _____ CONTRACTOR: _____ DATUM: _____
 TEMPERATURE (*F): _____ WEATHER: _____ GEOLOGIST: _____
 DRLG MED: _____

COMMENTS: _____

Depth (ft.)	Pro- file	USCS	Geologic Description	Split Spoon Interval	Laboratory Sample Identification	Sample Type	PID ppmv	Remarks
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

G - Grab Sample

decontamination operations.

All soil sampling tools will be prior to use and between each use as described below:

- Scrub the equipment with a solution of hot potable water and Alconox or equivalent laboratory-grade detergent. Rinse equipment with copious quantities of cold potable water followed by a reagent grade Type II water rinse.

- Rinse equipment with pesticide-grade methanol

- Rinse equipment with pesticide-grade hexane

- Air dry equipment on a clean surface such as Teflon, stainless steel, or aluminum. If the sampling device will not be used immediately after being decontaminated, it will be wrapped in aluminum foil shiny side out. All decontamination activities must be conducted in a manner so that all excess water, methanol, and hexane will be collected, containerized and deposited into the decontamination pad collection tanks.

Contaminated soil cuttings generated during drilling will be placed in US Department of Transportation (DOT) -approved, 55-gallon drums. The drums will be labeled with the site name, contents, drilling date, borehole number, and depth intervals. Drums will be taken to the Base hazardous waste storage area for temporary storage, following drilling activities. To minimize cuttings disposal costs, cuttings showing no field evidence of contamination (i.e., soil with PID and/or TVHA readings less than 25 ppmv above background, no petroleum odor, and no discoloration) will not be drummed with contaminated cuttings. "Clean" soil cuttings will be spread thinly on the ground surface near the site. Soils exhibiting petroleum hydrocarbon contamination based on PID screening will be drummed and stored onsite during drilling operations. Upon completion of the drilling activities, drummed soils will be transported to a local disposal facility. Elmendorf AFB will be responsible for signing the disposal manifest for the soil drums.

4.1.5 Borehole Abandonment

All boreholes will be abandoned by backfilling with bentonite chips or a Portland cement/sodium bentonite grout mixture to within approximately 3 feet of ground surface. If Portland cement/sodium bentonite grout is used, the bentonite content of the grout will not exceed 8 percent by dry weight. If standing water is present in the boring, the grout mixture will be placed using a tremie pipe placed below the static water level near the bottom of the boring. The grout mixture will be pumped through the tremie pipe until undiluted grout is present in the boring near ground surface.

Twenty-four hours after abandonment, the field engineer, or his designate, will check the abandoned site for grout settlement and specify additional grout, or backfill the hole to ground surface with clean native soil, as necessary.

4.2 SOIL SAMPLE ANALYSIS

Proposed sample analytical methods and detection limits are presented in Table 4.2. All samples will be analyzed by the Quanterra Laboratory in Arvada, Colorado, a State of Alaska-approved and AFCEE-approved laboratory. Parsons ES proposes to analyze samples from Site ST71 by approved methods referenced by the US Environmental Protection Agency (EPA) Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition as updated through January 1995. Method SW8015A Modified for TVPH as gasoline (GRO), SW8100 Modified for TEPH as diesel (DRO), and SW8020A for BTEX will be used. GRO results will be reported for carbon chain C6 through C10, and DRO results will be reported for carbon chain C10 through C28. These methods are identical to the methods used during the site investigation, and will be used subsequent to regulation 18 AAC 78.235(f). The results will be reported as described in the state UST procedures manual.

TABLE 4.2
PROPOSED SOIL SAMPLE ANALYTICAL METHODS AND
PRACTICAL QUANTITATION LIMITS

Analytical Method	PQL (mg/kg) ^{a/}
Site ST71	
EPA SW8015A Modified for Gasoline (GRO) ^{b/} (California Department of Health Services Method)	1.0
EPA SW8015 Modified for Diesel (DRO) ^{c/} (California Department of Health Services Method)	10.0
EPA SW8020A	
Benzene	0.001
Toluene	0.005
Ethylbenzene	0.005
Xylenes	0.05

Source: Engineering-Science, Inc. 1993.

^{a/} PQL = practical quantitation limit; mg/kg = milligrams per kilogram

^{b/} This corresponds to a n-alkane range from the peak start of C6 to the peak start of C10.

^{c/} This corresponds to a n-alkane range from the beginning of C10 to the beginning of C28.

SECTION 5

SITE CLOSURE REPORT FORMAT

Following receipt of the laboratory analytical results, a site closure report will be prepared and submitted to the ADEC, Elmendorf AFB, and AFCEE.

The report will contain the following information for each site:

- Plot plans showing final borehole locations;
- Summary of field activities;
- Assessment of analytical results in comparison to state cleanup criteria;
- Laboratory analytical reports and chain-of-custody forms;
- Borehole logs;
- Conclusions and recommendations for site closure or additional cleanup action;
and
- Further reporting as required by 18 AAC 78.340(a)

SECTION 6

PROJECT SCHEDULE

The following schedule is contingent upon approval of this sampling and analysis plan and completion of base support requirements.

<u>Event</u>	<u>Date</u>
Draft Sampling and Analysis Plan (SAP) to AFCEE/ Elmendorf AFB for review	22 January 1996
Draft Final SAP to Elmendorf AFB/ADEC for comment	11 March 1996
Final SAP to Elmendorf AFB/AFCEE/ADEC for approval	15 April 1996
Elmendorf AFB Personnel to Shut off Blower System	26 April 1996
3-Year Respiration Test	24 May 1996
Confirmation Soil Sampling	29 May 1996
Draft Site Closure Report to Elmendorf AFB/AFCEE for Review	26 July 1996
Draft Final Site Closure Report to Elmendorf AFB/ ADEC for Comment	August 1996
Final Site Closure Report to Elmendorf AFB/AFCEE/ ADEC for Approval	September 1996

SECTION 7

POINTS OF CONTACT

Mr. Claude Mayer
3 SPTG/CEVR
22040 Maple Street
Elmendorf AFB, AK 99506-3240
(907) 552-7507

Mr. Jerry Hansen and
Lt Maryann Jenner
AFCEE/ERT
Brooks AFB, TX 78235-5103
(210) 536-4353 (Mr. Hansen)
(210) 536-5688 (Lt Jenner)

Mr. Dave Teets and
Mr. John Ratz
Parsons Engineering Science, Inc.
1700 Broadway, Ste 900
Denver, CO 80290
(303) 831-8100

SECTION 8

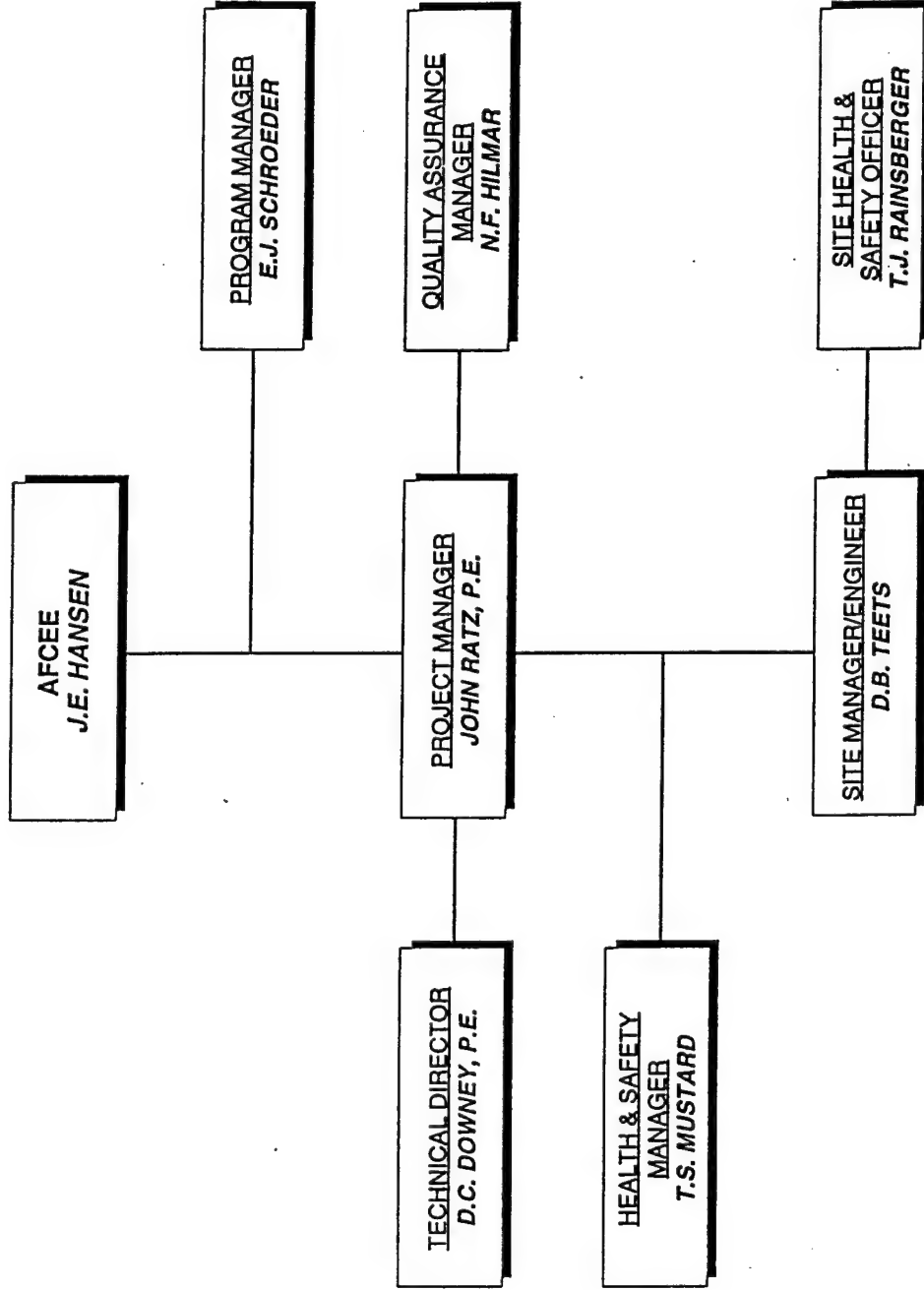
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- CH2M Hill. 1992. *Draft Operable Unit 4 LFI Report*. September.
- ENSR Consulting and Engineering. 1994. *Final SERA Phases 1A and 1B Site Assessment Report*. Prepared for 3rd SPTG/DEV, Elmendorf Air Force Base, Alaska. February.
- ENSR Consulting and Engineering. 1995. *Final SERA Phase 1 Corrective Action Plan*. Prepared for 3rd SPTG/DEV, Elmendorf Air Force Base, Alaska. April.
- Engineering-Science, Inc. 1993. *Standard Quality Assurance Program Plan for Underground Storage Tank Systems Regulated by 18 AAC 78*. Prepared for The Alaska Department of Environmental Conservation. June.
- Engineering-Science, Inc. 1993. *Draft Bioventing Pilot Test Interim Results Report for Sites ST43/55, ST61, and ST71*. Prepared for Air Force Center for Environmental Excellence. October.
- Jacobs Engineering Group. 1993. Environmental Restoration Program. *Management Action Plan - Final*. December.
- Jacobs Engineering Group. 1994. Environmental Restoration Program. Basewide Water Level Program. Fourth Quarterly Technical Memorandum. Period: October - December 1993. January.
- Mayer, Claude. 1995. Personal Communication. Data fax from Claude Mayer of 3rd SPTG/DEV, Elmendorf Air Force Base, to David Teets (Parsons Engineering Science, Inc.), December 26, 1995.
- Radian Corporation. 1993. Environmental Restoration Program. *Draft Remedial Investigation Report*, Operable Unit 4. February.
- US Air Force. 1995. Memorandum for 3 CES/CEVR, Elmendorf Air Force Base, concerning bioventing pilot test results at Site ST43/55, ST61, and ST71.

APPENDIX A

Organizational Chart and Employee Qualifications

PROJECT
ORGANIZATIONAL CHART



APPENDIX A

Qualified Personnel Form

Assessment Firm Name Parsons Engineering Science, Inc.
City, State, Zip Code Denver, Colorado 80290
Phone Number (303) 831-8100
Fax Number (303) 831-8100

This form must be submitted before any work conducted by the assessment firm under Chapter 2, Standard Sampling Procedures of the Underground Storage Tanks Procedures Manual. Resumes and any other pertinent documents must be submitted as attachments to demonstrate that the personnel listed below are "qualified" as defined in 18 AAC 78. The assessment firm shall notify ADEC of all amendments to this listing and submit documentation of personnel changes.

QUALIFIED PERSONNEL

- | | |
|-------------------------------|-------------------------|
| 1. Principal Investigator | <u>David B. Teets</u> |
| 2. QA Officer | <u>Norman F. Hilmar</u> |
| 3. <u>Tony J. Rainsberger</u> | 4. _____ |
| 5. _____ | 6. _____ |
| 7. _____ | 8. _____ |
| 9. _____ | 10. _____ |
| 11. _____ | 12. _____ |
| 13. _____ | 14. _____ |
| 15. _____ | 16. _____ |
| 17. _____ | 18. _____ |

Biographical Data

DAVID B. TEETS

Environmental Engineer

EXPERIENCE SUMMARY

Mr. Teets has experience in both environmental engineering and materials testing. He applies his knowledge to the cleanup of sites contaminated with fuels and other hazardous materials. He is particularly involved with the use of bioventing and bioremediation technologies for the *in situ* remediation of soils. He is also experienced in construction inspection and surveying.

EXPERIENCE RECORD

- 1992-Date Parsons Engineering Science, Inc. Environmental Engineer. Currently involved in a contract for the Air Force Center for Environmental Excellence (AFCEE) to conduct pilot tests to determine the suitability of bioventing/bioremediation to clean up fuel-contaminated soils at more than 100 Air Force sites across the nation. Responsible for coordinating and conducting pilot testing at more than 20 fuel-contaminated sites at 9 Air Force bases. Tasks include writing work plans, obtaining regulatory approval to conduct tests, system installation and start-up, and monitoring of remediation progress. Designed and installed a full-scale bioventing system to remediate soil contaminated with diesel and jet fuels at an Air Force base in Colorado.
- 1991-1992 ATEC Associates, Inc. Engineering Technician. Conducted strength of materials testing of concrete, soil and asphalt in the laboratory and field for construction quality control. Utilized laboratory analyses to determine optimum field conditions to achieve construction compliance. Participated in laboratory studies to determine the design mixtures of lime-treated subbase soils for runways at the new Denver International Airport (DIA). Also involved in training employees to conduct field and laboratory testing procedures at the DIA.
- 1991 Complete Engineering Services, Inc. Engineering Assistant. Oversaw the construction of a roadway near Vail, Colorado. Had sole responsibility for development and implementation of field and laboratory QA/QC inspection and testing program, final report preparation, and set-up of onsite soil laboratory. Performed field and laboratory soil testing to determine construction guidelines and compliance. Also performed soil percolation testing to determine design criteria for several leach fields.
- 1990 City of Englewood. Engineering Assistant. Assisted surveyors and engineers in services supporting the construction of roadways. Responsibilities included field and laboratory testing of soil and concrete, surveying, and construction inspections.

EDUCATION

B.S. in Civil Engineering with Environmental Science and Management Minors, 1992, Colorado School of Mines, Golden, Colorado

DAVID B. TEETS
Environmental Engineer
Page 2

SPECIAL TRAINING

OSHA 40-hour health and safety training for work at hazardous waste sites
OSHA 8-hour supervisors training for work at hazardous waste sites
OSHA Competent training for work on construction sites
Red Cross adult CPR and standard first aid training
Quality improvement fundamentals

PROFESSIONAL AFFILIATION/REGISTRATIONS

Registered Engineer in Training (Colorado, 1991, No. 18319)

Biographical Data

ANTHONY J. RAINSBERGER

Environmental Engineer

EXPERIENCE SUMMARY

Experienced in site investigations, treatability studies, feasibility studies, and modeling to characterize and remediate hazardous waste sites. This includes conducting detailed analyses of contaminant attenuation in groundwater, modeling contaminant fate and transport, and conducting pilot-scale treatability tests. Has also performed detailed analyses of biological degradation processes of chlorinated solvents in groundwater.

EXPERIENCE RECORD

- 1994 - Date Parsons Engineering Science, Inc. **Environmental Engineer.** Responsible for analyzing and evaluating chemical fate and transport factors for both petroleum hydrocarbons and chlorinated solvents contamination. Evaluates biological degradation mechanisms acting within chlorinated solvent plumes. Developed both work plans and remedial action plans to support a risk-based approach to remediation for petroleum hydrocarbon contamination. Also prepared and implemented work plans to remediate both surface and subsurface soils contaminated with chlorinated solvents.
- 1993-1994 U.S. Air Force. **Environmental Engineer.** Managed RCRA site plan during base closure operations. Conducted environmental assessments of closure buildings. Served as the management planner for the base asbestos program. Task manager for aboveground storage tank removal at the base aero club. Assessed power plant emissions to determine compliance with regulatory requirements.
- 1992 Dow Chemical. **Project Engineer.** Restored severely corroded acid loading/unloading station for rail cars. Replaced 32,000-gallon aboveground storage tank. Updated operation procedure library files for ISO 9000. Installed zinc chloride recovery sump system.
- 1991-1992 Department of Agricultural and Chemical Engineering, Colorado State University. **Research Assistant.** Assembled a solid state fermentor for fungal degradation of lignin to free encapsulated proteins. Perform batch lignin degradation test on a variety of substrates.
- 1991 Amoco Production Company. **Field Engineer.** Technically evaluated the efficiency of biolagoon system for treating discharge water. Established operating procedures for landfarming elemental sulfur from gas plant. Explored production water parameters in piping runs exhibiting corrosion problems.
- 1989-1991 Department of Agricultural and Chemical Engineering, Colorado State University. **Research Assistant.** Prepared preliminary designs of a trichloroethylene degrading bioreactor. This included batch sample rate testing of biodegradation rates for differing microbes and material compatibility testing for reactor design. Performed scanning electron microscope investigations in microbial adhesion to various reactor support matrices.

EDUCATION

B.S. in Chemical Engineering, 1992, Colorado State University, Fort Collins, Colorado

Anthony J. Rainsberger
Environmental Engineer
Page 2

SPECIAL TRAINING

OSHA 40-hour health and safety training for work at hazardous waste sites with annual 8-hour refreshers.
RCRA facility compliance training at DOD installations
EPA accredited asbestos inspector/management planner
Post-graduate course work in groundwater hydrology and bioremediation
Quality improvement fundamentals

PUBLICATIONS AND PRESENTATION

"Inferring Biodegradation Processes for Trichloroethene from Geochemical Data," In Situ and On-Site Bioreclamation: The Third International Symposium Proceedings, San Diego, California, April, 1995 (co-authors P.R. Guest and L.A. Benson)

Biographical Data

NORMAN F. HILMAR

Program Quality Assurance Manager

EXPERIENCE SUMMARY

More than 20 years of experience in management and development of nuclear quality assurance (QA) programs; audits of nuclear and non-nuclear projects; environmental QA programs; waste management programs; environmental protection plans and procedures; decontamination and decommissioning; ASME NQA-1 quality assurance and quality control (QA/QC) programs for nuclear power plants, boilers, and pressure vessels; mechanical/electrical equipment inspection; and operation and maintenance. Experience also includes task management of mixed waste storage facility design, fire protection, regulatory compliance, project controls, scheduling, and cost estimating.

EXPERIENCE RECORD

1981-Date Parsons Engineering Science, Inc. Program Quality Assurance Manager. (1993-Date). Responsible for development and management of a programmatic quality assurance program for multi-task environmental remediation and waste management support services at the U.S. Department of Energy's (DOE's) Rocky Flats Environmental Technology Site (RFETS) near Golden, Colorado. Responsibilities include QA program development, training, audits, assessments, surveillances, quality improvement, corrective actions, and quality problem resolution meeting the requirements of DOE Order 5700.6C, ASME NQA-1, EPA QAMS 005/80, and ANSI/ASQC E4 (draft).

Quality Assurance Specialist (1993). Developed Quality Assurance Requirements Identification Document (SRID) for the Hanford T-Plant for Westinghouse Hanford Company and DOE that incorporated the requirements of DOE Order 5700.6C, ASME NQA-1, NQA-2, and EPA QAMS 005/80 in addition to other Hanford site-specific requirements documents.

Project Quality Assurance Manager (1985-1993). Responsible for development and management of nuclear and environmental QA programs, plans, and procedures for basic ordering agreements at the RFETS, the Fuel Processing Restoration (FPR) project at Idaho National Engineering Laboratory (INEL), various projects at Los Alamos National Laboratories (LANL), the Laboratory 222-S project at Hanford site, and the Specific Manufacturing Capabilities (SMC) facility at INEL under ASME NQA-1, quality program requirements. Performed nuclear QA audits and surveillances of project activities. Interfaced with client and project management on resolution and corrective action of quality problems. Performed training and indoctrination of project personnel in nuclear quality requirements. Supervised field QA engineering effort related to construction inspection activities for the SMC project. Reviewed all design, procurement, and construction documents for quality requirements. Reviewed piping orthographics, isometrics, process flow diagrams, HVAC, fire protection, structural, electrical, instrumentation, and specifications for conformance to federal, state, and local codes and standards.

Task Manager (1992-1993). Responsible for management, design, and regulatory compliance of low-level mixed waste (LLMW) storage facilities at LANL. Responsibilities included management of engineering disciplines, architectural, heating and ventilation, fire protection piping and equipment, RCRA and EPA regulatory compliance, project controls, scheduling, and cost estimating. Developed options for upgrading existing LLMW storage facilities to meet RCRA, NFPA, OSHA, and other applicable standards and regulations. Also developed preconceptual design for new low-level mixed waste storage facilities to

NORMAN F. HILMAR
Program QA Manager
Page 2

meet current regulations based on LANL waste generation, waste treatment work-off rates, and existing site storage capabilities.

Project Quality Assurance Engineer (1989-1990). Responsible for developing the Quality Assurance Program and Data Verification Section for the Environmental Protection Implementation Plan (EPIP) for the DOE Pantex Plant in conformance with DOE Orders 5400.1, 5820.2A, 5700.6B, and ASME NQA-1. The QC program covered independent data verification, chain of custody, field and laboratory QC, laboratory certification, performance reporting, records, audits, and other QA elements required for the Pantex Plant environmental monitoring and surveillance program.

Quality Assurance Engineer (1981-1985). For ASME NQA-1 nuclear programs, responsible for quality assurance audits, development of project quality assurance programs, and review of nuclear design documents for inclusion of quality requirements. Performed quality assurance audits of non-nuclear projects; review of engineering drawings, specifications, and vendor QA/QC programs for quality requirements. Responsible for quality assurance and quality control programs for ASME Section III and Sections I and VIII systems. Trained company personnel in preparation for ASME audits for renewal of ASME Certificates of Authorization (power boilers, pressure vessels, nuclear power plants). Utilized NQA-1, NQA-2, 10CFR50 Appendix B, N45.2, ANSI, ASTM, AWS, and ASME Codes and Standards.

1973-1977 **Chubb Pacific Indemnity. Engineering Supervisor.** Responsible for management, training, performance appraisal, and job assignments for six ASME authorized inspectors who provided inspection of mechanical and electrical equipment at various industrial complexes. Responsible for determining root cause analysis of equipment failure and company liability, developing preventive maintenance programs and documentation, expediting repairs, and locating repair facilities.

1966-1970 **U.S. Merchant Marine. Marine Engineering Officer.** As engineering officer, was responsible for supervising engineering personnel in operations and maintenance of power plant systems and other mechanical and electrical equipment. Licensed as a first assistant engineer, steam vessels, and third assistant engineer, diesel vessels, unlimited.

EDUCATION

B.S., 1972, Mechanical Engineering Technology, California Polytechnic State University
B.S., 1966, Marine Engineering, California Maritime Academy

SPECIAL TRAINING

OSHA 40-hour health and safety training for work at hazardous waste sites in accordance with 29 CFR 1910.120, 40 CFR 264.16 with annual 8-hour refresher courses.
Quality Improvement Fundamentals

REGISTRATIONS

Certified Nuclear (NQA-1) Lead Auditor, 1985-Date
Certified Mechanical Engineering Technologist, NICET, 1993
Authorized Inspector, National Board of Boilers and Pressure Vessels, 1973
Engineers License, Marine Engineering, U.S. Merchant Marine, 1969

APPENDIX B .

FIELD BOREHOLE LOGS

GEOLOGIC BORING LOG

JOB NUMBER.:	726876.41122	CLIENT:	AFCEE/Elmendorf AFB	DATE:	5/28/96
BORING NUMBER:	49BH06	BORING DIA.:	8-inch	ELEVATION:	
RIG TYPE:		CONTRACTOR:	Denali Drilling	DATUM:	
TEMPERATURE (°F):	~50°F	WEATHER:	Cloudy, sl breeze	GEOLOGIST:	DBT
		DRLG MED:	HSA		

COMMENTS:

Depth (ft.)	Pro- file	USCS	Geologic Description	Split Spoon Interval	Laboratory Sample Identification	Sample Type	PID ppmv	Remarks
1								
2								
3								1330
4		GP	3.5-5': gravel, cobbles, sandy, m-c, sm silt, brn, sl moist, no staining or odor	X		SS		BH = 1.2/1.2 BZ = 1.2/1.2 CS' PID = 3.7/1.0
5								
6			5.7-7': SAA	X		SS		1340 0.7' PID = 10.2/1.0 BH = 0.2/0.2 BZ = 0.2/0.2
7								
8			7.5-9': SAA except sm blk staining, no odor	X		SS		1347 0.9, 5' PID = 20.2/1.0
9								
10			9.5-11': SAA except large cobbles	X	49BH06- 9.5	SS 1.5-10'		1355 0.10' PID = 17.4/0.8
11								
12			11.5-13 SAA except wet	X	49BH06-11.5 49BH06-21.5 (duplicate)	SS 11.5-12 12-12.5		1405 0.17.5' PID = 9.1/0.6
13								
14								TD = 13' bgs
15								
16								
17								
18								
19								
20								

PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

G - Grab Sample

PARSONS ENGINEERING SCIENCE, INC.

GEOLOGIC BORING LOG

JOB NUMBER.: 726876.41122 CLIENT: AFCEE/Elmendorf AFB DATE: 5/28/96
 BORING NUMBER: 49BH07 BORING DIA.: 8-inch ELEVATION:
 RIG TYPE: Mobil B61 CONTRACTOR: Demali Drilling DATUM:
 TEMPERATURE (*F): ~50°F WEATHER: Cldy, calm GEOLOGIST: D&T
 DRLG MED: HSA
 COMMENTS: Boring between Vml times

Depth (ft.)	Pro- file	USCS	Geologic Description	Split Spoon Interval	Laboratory Sample Identification	Sample Type/ Depth	PID ppmv	Remarks
1								BZ - Breathing Zone
2								
3								1135
4								
5		GP	4.5-5 Gravel, cobbles, sandy, m-c, brn, sl moist, no staining, no odor	X		SS		0.5' PID = 10.1/0.0 BH = 3.0/1.3 BZ = 1.3/1.3
6			6-7 SAA	X		SS		1135
7				X				0.7' PID = 4.0/0.0 BH = 0.7/0.7 BZ = 0.7/0.7
8				X		SS		11:45
9			8-9: SAA except, tr clay, tr iron oxide staining, sl blk staining, no odor	X				0.9' PID = 14.0/1.0 BH = 8.1/1.0 BZ = 1.0/1.0 1155
10			9.5-11 Gravel, cobbles, sandy, f-m, brn, sm black charcoal-like material, moist, no odor.	X	49BH07-10.5	SS 10.5-11		0.10' PID = 8.4/1.0 BH = 1.2/1.2 BZ = 1.2/1.2
11				X				1205
12			11.5-13 SAA except blk staining, mild petroleum odor, wet	X	49BH07-12	SS 12-12.5		0.13' PID = 2.44/1.0 TD = 13' bgs
13								
14								
15								
16								
17								
18								
19								
20								

PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

Bkgnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

G - Grab Sample

PARSONS ENGINEERING SCIENCE, INC.

GEOLOGIC BORING LOG

JOB NUMBER.: 726876.41122 CLIENT: AFCEE/Elmendorf AFB DATE: 5/28/96
 BORING NUMBER: 49BH08 BORING DIA.: 8-inch ELEVATION: _____
 RIG TYPE: Mobile B61 CONTRACTOR: Denali Drilling DATUM: _____
 TEMPERATURE (°F): -45°F WEATHER: Overcast, -45°F, W breeze GEOLOGIST: DBT
 DRLG MED: Auger, Hollow stem
 COMMENTS: Closure Soil Sampling

Depth (ft.)	Pro- file	USCS	Geologic Description	Split Spoon Interval	Laboratory Sample Identification	Sample Type/	PID ppmv	Remarks
1						Depth		BZ=Breathing Zone
2								Reading/bkgnd
3								
4			4-5.5'					10:00
5		GP	Gravel, sandy, m-c, brn, sl moist, no odor or staining.	X		SS	25' 6.7/DBT	BZ=7.4/7.4 BH=7.4/7.4 PID=12.2/5.6
6								10:05
7			6.5-7.5 SAA	X		SS		BZ=7.6/7.6 BH=7.6/7.6
8			7.5-9 SAA	X				47 PID=23.2/6.7
9		CL GP	9.0-9.25 Clay, fat silty, lt brn, sl moist	X				10:15
10			9.25-10 Gravel, sandy, m-c, brn/bk, moist no odor or staining	X		SS		BZ=7.6/7.6 BH=7.6/7.6 PID=10.7/6.5
11								10:25
12			11-12.5 SAA except moist	X	49BH08-11.5	SS		BZ=5.7/5.7 BH=21.0/5.7
13							11.5-12	11' PID=25.9/6.5
14			13-15 Gravel, sandy, dark brn, v. moist/wet no odor or staining	X	49BH08-13	SS		10:45
15							13.5-14	BH=22.3/5.7 213' PID=293.6/6.4
16								TPD=15' bgs
17								
18								
19								
20								

PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

Bkgnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

G - Grab Sample

PARSONS ENGINEERING SCIENCE, INC.

GEOLOGIC BORING LOG

JOB NUMBER.: 726876.41122 CLIENT: AFCEE/Elmendorf AFB DATE: 5/28/96
 BORING NUMBER: 49BH09 BORING DIA.: 8-inch ELEVATION: _____
 RIG TYPE: _____ CONTRACTOR: Denali Drilling DATUM: _____
 TEMPERATURE (*F): ~50°F WEATHER: Cldy, sl breeze GEOLOGIST: DBT
 DRLG MED: HSA

COMMENTS: _____

Depth (ft.)	Pro- file	USCS	Geologic Description	Split Spoon Interval	Laboratory Sample Identification	Sample Type/ Depth	PID ppmv	Remarks
1								
2								
3								
4								
5								
6								
7								
8								
9								1450
10		GP	9-11' Gravel / sandy, m.c, brn, dry no staining, or odor	X				10' PID = 1.0/1.0
11			11.5-13 SAA except moist					1500 PID @ 11.5 = 1.0/1.0
12				X	ms/msd - 49BH09-13	SS 12.5-13, 12.5-13		1510
13								15' PID = 2.0/1.0
14			13.5-15 SAA except sm blk material, wet	X	49BH09-14.5	SS 14-14.5		TD = 15' bgs
15								
16								
17								
18								
19								
20								

PID - Photoionization Detector

BH - Borehole

SAA - Same As Above

Bkgrnd - Background

HSA - Hollow Stem Auger

ft - Feet

bgs - Below Ground Surface

na - Not Analyzed

ppmv - Parts per Million, Volume per Volume

HS - Sample Headspace

SS - Split Spoon Sample

BS - Brass Sleeve Sample

G - Grab Sample

PARSONS ENGINEERING SCIENCE, INC.

APPENDIX C

LABORATORY ANALYTICAL RESULTS

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

September 11, 1996

Mr. David Teets
Parsons Engineering Science
1700 Broadway, Suite 900
Denver, Colorado 80290

Dear Mr. Teets:

Enclosed please find a copy of laboratory non-conformance memo (NCM)#005235 which you requested. The copy of this NCM in your final report was not readable.

In addition, the method reference for the BTEX analysis performed on Quanterra samples 049298-0001 through -0011 is 8020A. As we discussed during our telephone conversation, the method references in our laboratory information management system (LIMS), which appear on the data sheets, do not include the revision numbers for the method (i.e. 8020A).

Please let me know if you have any other questions.

Sincerely,



Ellen La Riviere
Program Manager

enclosure

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

Mr. David Teets
Parsons Engineering Science
1700 Broadway, Suite 900
Denver, Colorado 80290

Dear Mr Teets:

Enclosed is the report for nine soil samples and three aqueous samples received at Quanterra's Denver Laboratory on May 30, 1996. Included with the report is a quality control summary.

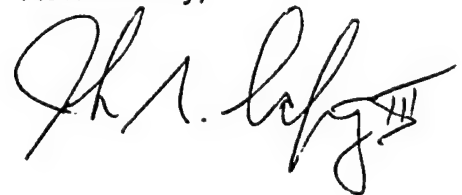
Please call if you have any questions.

Sincerely,



Ellen La Riviere
Project Manager

Reviewed by,



Enclosures

Quanterra #049298

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

ANALYTICAL RESULTS
FOR
PARSONS ENGINEERING SCIENCE
QUANTERRA ENVIRONMENTAL SERVICES
DENVER LABORATORY # 049298

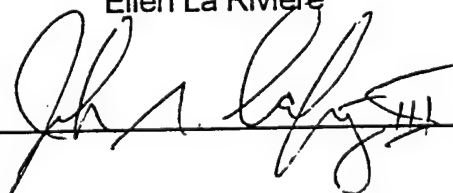
JUNE 19, 1996

Prepared by:



Ellen La Riviere

Reviewed by:



LIMs Report Key

Section	Description
Cover Letter	Signature page, report narrative as applicable.
Sample Description Information	Tabulated cross-reference between the Lab ID and Client ID, including matrix, date and time sampled, and the date received for all samples in the project.
Sample Analysis Results Sheets	Lists sample results, test components, reporting limits, dates prepared and analyzed, and any data qualifiers. Pages are organized by test.
QC LOT Assignment Report	Cross-reference between lab IDs and applicable QC batches (DCS, LCS, Blank, MS/SD, DU)
Duplicate Control Sample Report	Percent recovery and RPD results, with acceptance limits, for the laboratory duplicate control samples for each test are tabulated in this report. These are measures of accuracy and precision for each test. Acceptance limits are based upon laboratory historical data.
Laboratory Control Sample Report	Percent recovery results for a single Laboratory Control Sample (if applicable) are tabulated in this report, with the applicable acceptance limits for each test.
Matrix Spike/Matrix Spike Duplicate Report	Percent recovery and RPD results for matrix-specific QC samples and acceptance limits, where applicable. This report can be used to assess matrix effects on an analysis.
Single Control Sample Report	A tabulation of the surrogate recoveries for the blank for organic analyses.
Method Blank Report	A summary of the results of the analysis of the method blank for each test.

List of Abbreviations and Terms

Abbreviation	Term	Abbreviation	Term
DCS	Duplicate Control Sample	MSD	Matrix Spike Duplicate
DU	Sample Duplicate	QC Run	Preparation Batch
EB	Equipment Blank	QC Category	LIMs QC Category
FB	Field Blank	QC Lot	DCS Batch
FD	Field Duplicate	ND	Not Detected at or above the reporting limit expressed
IDL	Instrument Detection Limit (Metals)	QC Matrix	Matrix of the laboratory control sample(s)
LCS	Laboratory Control Sample	RL	Reporting Limit
MB	Method Blank	QC	Quality Control
MDL	Method Detection Limit	SA	Sample
MS	Matrix Spike	SD	Spike Duplicate
RPD	Relative Percent Difference	TB	Trip Blank
ppm (part-per-million)	mg/L or mg/kg (usually)	ppb (part-per-billion)	ug/L or ug/kg (usually)
QUAL	Qualifier flag	DIL	Dilution Factor

I. OVERVIEW

On May 30, 1996, Quanterra Environmental Services' Denver Laboratory received nine soil samples and three aqueous samples from Parsons Engineering Science, Inc.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

- I. Overview
- II. Sample Description Information/Analytical Test Requests
- III. Analytical Results
- IV. Quality Control Report

"J" values have been reported for the volatiles analyses. A "J" value indicates an estimated value. For gas chromatography analyses, a "J" value is where the mass spectra data indicate the result is less than the reporting limit but greater than the method detection limit (MDL). Analytes that were not detected at or below the reporting limit are reported as "ND" and do not have "J" flags. Because "J values" may represent false positive concentrations, care should be used when interpreting these data.

Method 8020 Data Review

Each sample was analyzed to achieve the lowest possible reporting limits within the constraints of the method. In some cases, due to interferences, or analytes present at concentrations above the linear calibration curve, samples are diluted. For diluted samples, the reporting limits are raised relative to the dilutions required. Quanterra sample 049298-0005-SA was analyzed at a dilution for Method 8020-BTEX, due to the presence of non-target compounds in the sample. As a result of the dilutions required, the a,a,a-Trifluorotoluene surrogate was diluted to less than detectable concentrations in the sample.

The a,a,a-Trifluorotoluene surrogate in the primary column for Quanterra sample 049298-0008-SA exceeded the Quanterra quality control limits. Because this surrogate was within acceptable limits in the secondary column, a matrix effect is indicated and no further action was required.

Gasoline Range Organics Data Review

Quanterra sample 049298-0005-SA was diluted for Gasoline Range Organics analysis due to the concentration of the target analyte in the sample. The reporting limits were raised accordingly. As a result of the dilution required, the a,a,a-Trifluorotoluene surrogate was diluted to less than detectable concentrations.

Diesel Range Organics Data Review

Quanterra samples 049298-0003-SA and 0005-SA were diluted for Diesel Range Organics analysis due to the concentration of the target analyte in the samples. The reporting limits were raised accordingly. As a result of the dilution required, the a,a,a-Trifluorotoluene surrogate was diluted to less than detectable concentrations in Quanterra sample 049298-0005-SA.

With the exceptions noted above, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

SAMPLE DESCRIPTION INFORMATION
for
Parsons Engineering Science

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
049298-0001-FB	49FB	WATER-QA	28 MAY 96	09:00	30 MAY 96
049298-0002-SA	49BH08-11.5	SOIL	28 MAY 96	10:25	30 MAY 96
049298-0003-SA	49BH08-13	SOIL	28 MAY 96	10:45	30 MAY 96
049298-0004-SA	49BH07-10.5	SOIL	28 MAY 96	11:55	30 MAY 96
049298-0005-SA	49BH07-12	SOIL	28 MAY 96	12:05	30 MAY 96
049298-0006-SA	49BH06-9.5	SOIL	28 MAY 96	13:55	30 MAY 96
049298-0007-SA	49BH06-11.5	SOIL	28 MAY 96	14:05	30 MAY 96
049298-0008-SA	49BH06-21.5	SOIL	28 MAY 96	14:25	30 MAY 96
049298-0009-SA	49BH09-13	SOIL	28 MAY 96	15:00	30 MAY 96
049298-0009-MS	MS/MSD	SOIL	28 MAY 96	15:00	30 MAY 96
049298-0009-SD	MS/MSD	SOIL	28 MAY 96	15:00	30 MAY 96
049298-0010-SA	49BH09-14.5	SOIL	28 MAY 96	15:10	30 MAY 96
049298-0011-TB	TRIP BLANK	WATER-QA	28 MAY 96	15:20	30 MAY 96
049298-0012-RB	RB	WATER-QA	28 MAY 96	14:40	30 MAY 96

ANALYTICAL TEST REQUESTS
for
Parsons Engineering Science

Lab ID: 049298	Group Code	Analysis Description	Custom Test?
0002 - 0010	A	BTEX by Method 8020 Prep - Hydrocarbons by GC Percent Water AFCEE Extractable Petroleum Hydrocarbons AFCEE Gasoline Range Organics BTEX by Method 8020-2nd Column	N N N N N N N
0001 , 0011	B	Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)	N
0012	C	Prep - Hydrocarbons by GC AFCEE Extractable Petroleum Hydrocarbons	N N N

Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49FB
Lab ID: 049298-0001-FB
Matrix: WATER-QA
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Units	Reporting Limit	
Benzene	ND	ug/L	0.50	JB
Toluene	0.064	ug/L	0.50	
Ethylbenzene	ND	ug/L	0.50	
Xylenes (total)	ND	ug/L	0.50	
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	90	%	70-130	

Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.

J = Result is detected below the reporting limit or is an estimated concentration.

ND = Not Detected

Reported By: Kenneth Aten

Approved By: Karen Kuiken

BTEX by Method 8020
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH08-11.5
Lab ID: 049298-0002-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	1.6	ug/kg	5.2	Jd
Toluene	3.2	ug/kg	5.2	JM
Ethylbenzene	1.6	ug/kg	5.2	Jd
Xylenes (total)	3.3	ug/kg	5.2	JM
Surrogate	Recovery:		Limits	
a,a,a-Trifluorotoluene	105	%	20-160	

Percent moisture is 4.4%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020-2nd Column
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH08-11.5
Lab ID: 049298-0002-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	1.3	ug/kg	5.2	JM
Toluene	4.1	ug/kg	5.2	Jd
Ethylbenzene	1.1	ug/kg	5.2	JM
Xylenes (total)	6.8	ug/kg	5.2	d
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	104	%	20-160	

Percent moisture is 4.4%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH08-13
Lab ID: 049298-0003-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit
Benzene	ND	ug/kg	5.6
Toluene	ND	ug/kg	5.6
Ethylbenzene	140	ug/kg	5.6
Xylenes (total)	ND	ug/kg	5.6
Surrogate	Recovery		Limits
a,a,a-Trifluorotoluene	58	%	20-160

Percent moisture is 10.1%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020-2nd Column
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH08-13
Lab ID: 049298-0003-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	5.6	
Toluene	ND	ug/kg	5.6	
Ethylbenzene	32	ug/kg	5.6	M
Xylenes (total)	ND	ug/kg	5.6	
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	58	%	20-160	

Percent moisture is 10.1%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

M = Preferred Result
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH07-10.5
Lab ID: 049298-0004-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	1.3	ug/kg	5.2	Jd
Toluene	2.3	ug/kg	5.2	JM
Ethylbenzene	2.8	ug/kg	5.2	Jd
Xylenes (total)	9.8	ug/kg	5.2	d
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	100	%	20-160	

Percent moisture is 3.3%.
Dilution factor is 1.0.

All results and limits are reported on a dry weight basis.
All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result

Reported By: Corey Crooks

Approved By: Karen Kuiken

Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH07-12
Lab ID: 049298-0005-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 10 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	540	
Toluene	ND	ug/kg	540	
Ethylbenzene	1500	ug/kg	540	d
Xylenes (total)	4600	ug/kg	540	d
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	ND	%	70-130	

Percent moisture is 7.9%.
Dilution factor is 10.

All results and limits are reported on a dry weight basis.
All results and limits are corrected for dilution.

d = See Preferred Result
ND = Not Detected

Reported By: Kenneth Aten

Approved By: Karen Kuiken

Client Name: Parsons Engineering Science
Client ID: 49BH07-10.5
Lab ID: 049298-0004-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	5.2	M
Toluene	3.8	ug/kg	5.2	Jd
Ethylbenzene	2.6	ug/kg	5.2	JM
Xylenes (total)	9.4	ug/kg	5.2	M
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	100	%	20-160	

Percent moisture is 3.3%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

Client Name: Parsons Engineering Science
Client ID: 49BH07-12
Lab ID: 049298-0005-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 10 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	540	
Toluene	ND	ug/kg	540	
Ethylbenzene	ND	ug/kg	540	M
Xylenes (total)	2100	ug/kg	540	M
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	ND	-%	70-130	

Percent moisture is 7.9%.
Dilution factor is 10.

All results and limits are reported on a dry weight basis.
All results and limits are corrected for dilution.

M = Preferred Result
ND = Not Detected

Reported By: Kenneth Aten

Approved By: Karen Kuiken

BTEX by Method 8020
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH06-9.5
Lab ID: 049298-0006-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	5.2	
Toluene	3.8	ug/kg	5.2	JM
Ethylbenzene	5.3	ug/kg	5.2	d
Xylenes (total)	6.8	ug/kg	5.2	d
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	95	%	20-160	

Percent moisture is 3.5%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020-2nd Column
Method 8020.



Client Name: Parsons Engineering Science
Client ID: 49BH06-9.5
Lab ID: 049298-0006-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	5.2	
Toluene	5.1	ug/kg	5.2	Jd
Ethylbenzene	1.0	ug/kg	5.2	JM
Xylenes (total)	3.8	ug/kg	5.2	JM
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	99	%	20-160	

Percent moisture is 3.5%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

Client Name: Parsons Engineering Science
Client ID: 49BH06-11.5
Lab ID: 049298-0007-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	1.2	ug/kg	5.4	Jd
Toluene	1.5	ug/kg	5.4	JM
Ethylbenzene	11	ug/kg	5.4	d
Xylenes (total)	10	ug/kg	5.4	d
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	121	%	20-160	

Percent moisture is 7.9%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020-2nd Column
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH06-11.5
Lab ID: 049298-0007-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	5.4	M
Toluene	2.7	ug/kg	5.4	Jd
Ethylbenzene	1.5	ug/kg	5.4	JM
Xylenes (total)	5.7	ug/kg	5.4	M
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	100	%	20-160	

Percent moisture is 7.9%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH06-21.5
Lab ID: 049298-0008-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	5.5	
Toluene	ND	ug/kg	5.5	M
Ethylbenzene	1.5	ug/kg	5.5	Jd
Xylenes (total)	1.5	ug/kg	5.5	JM
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	167	%	20-160	

Percent moisture is 8.8%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020-2nd Column
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH06-21.5
Lab ID: 049298-0008-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	5.5	
Toluene	1.6	ug/kg	5.5	Jd
Ethylbenzene	0.96	ug/kg	5.5	JM
Xylenes (total)	3.2	ug/kg	5.5	Jd
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	104	%	20-160	

Percent moisture is 8.8%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH09-13
Lab ID: 049298-0009-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 04 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit
Benzene	ND	ug/kg	5.1
Toluene	ND	ug/kg	5.1
Ethylbenzene	ND	ug/kg	5.1
Xylenes (total)	ND	ug/kg	5.1
Surrogate	Recovery		Limits
a,a,a-Trifluorotoluene	102	%	20-160

Percent moisture is 2.3%.
Dilution factor is 1.0.

All results and limits are reported on a dry weight basis.
All results and limits are corrected for dilution.

ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH09-14.5
Lab ID: 049298-0010-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	5.3	
Toluene	ND	ug/kg	5.3	
Ethylbenzene	ND	ug/kg	5.3	
Xylenes (total)	2.1	ug/kg	5.3	JM
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	125	%	20-160	

Percent moisture is 5.5%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

BTEX by Method 8020-2nd Column
Method 8020



Client Name: Parsons Engineering Science
Client ID: 49BH09-14.5
Lab ID: 049298-0010-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Benzene	ND	ug/kg	5.3	
Toluene	ND	ug/kg	5.3	
Ethylbenzene	ND	ug/kg	5.3	
Xylenes (total)	2.6	ug/kg	5.3	Jd
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	103	%	20-160	

Percent moisture is 5.5%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

d = See Preferred Result
J = Result is detected below the reporting limit or is an estimated concentration.
ND = Not Detected

Reported By: Corey Crooks

Approved By: Karen Kuiken

Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)
Method 8020



Client Name: Parsons Engineering Science
Sample ID: TRIP BLANK
Job ID: 049298-0011-TB
Matrix: WATER-QA
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Units	Reporting Limit	
Benzene	ND	ug/L	0.50	JB
Toluene	0.16	ug/L	0.50	
Ethylbenzene	ND	ug/L	0.50	
Xylenes (total)	ND	ug/L	0.50	
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	91	%	70-130	

Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.

J = Result is detected below the reporting limit or is an estimated concentration.

ND = Not Detected

Prepared By: Kenneth Aten

Approved By: Karen Kuiken

AFCEE^Gasoline Range Organics
Method 8015 Modified



Client Name: Parsons Engineering Science
Client ID: 49BH08-11.5
Lab ID: 049298-0002-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Gasoline Range Organics	0.84	mg/kg	1.3	JBq
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	100	%	75-125	

Percent moisture is 4.4%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.
J = Result is detected below the reporting limit or is an estimated concentration.
q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Kenneth Aten

Approved By: Karen Kuiken

AFCEE^Gasoline Range Organics
Method 8015 Modified



Client Name: Parsons Engineering Science

Site ID: 49BH08-13
ID: 049298-0003-SA

Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Gasoline Range Organics	30	mg/kg	1.4	Bq
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	96	%	75-125	

Percent moisture is 10.1%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.

= This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Kenneth Aten

Approved By: Karen Kuiken

AFCEE^Gasoline Range Organics
Method 8015 Modified



Client Name: Parsons Engineering Science
Client ID: 49BH07-10.5
Lab ID: 049298-0004-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Gasoline Range Organics	3.3	mg/kg	1.3	Bq
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	98	%	75-125	

Percent moisture is 3.3%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.

q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Kenneth Aten

Approved By: Karen Kuiken

DUPLICATE CONTROL SAMPLE REPORT
Analyses by Chromatography

Analyte	Spiked	Concentration		AVG	Accuracy		Precision	
		DCS1	Measured DCS2		Average (%)	(RPD)	DCS Limits	DCS Limits

Category: 8020-A
Matrix: AQUEOUS
QC Lot: 05 JUN 96-P
Concentration Units: ug/L

Benzene	20.0	18.4	17.7	18.0	90	71-125	3.9	10
Toluene	20.0	17.7	17.9	17.8	89	80-119	1.1	10
Chlorobenzene	20.0	18.5	18.7	18.6	93	84-117	1.1	10
Ethylbenzene	20.0	18.6	18.7	18.6	93	84-117	0.54	10
Xylenes (total)	60.0	55.9	56.4	56.2	94	83-118	0.89	10
1,3-Dichlorobenzene	20.0	18.4	18.7	18.6	93	81-129	1.6	10
1,4-Dichlorobenzene	20.0	18.5	19.0	18.8	94	83-117	2.7	10
1,2-Dichlorobenzene	20.0	17.5	17.9	17.7	89	83-118	2.3	10

Category: 8020-SL
Matrix: SOIL
QC Lot: 04 JUN 96-H
Concentration Units: ug/kg

Benzene	50.0	47.0	47.0	47.0	94	39-150	0.0	25
Toluene	50.0	46.0	46.7	46.4	93	46-148	1.5	25
Chlorobenzene	50.0	49.5	49.3	49.4	99	55-135	0.40	25
Ethylbenzene	50.0	47.0	48.1	47.6	95	32-160	2.3	25
Xylenes (total)	150	144	146	145	97	65-135	1.4	25
1,3-Dichlorobenzene	50.0	49.7	48.6	49.2	98	50-141	2.2	25
1,4-Dichlorobenzene	50.0	48.8	49.1	49.0	98	42-143	0.61	25
1,2-Dichlorobenzene	50.0	48.6	48.6	48.6	97	37-154	0.0	25

Category: 8015G-AF-S
Matrix: SOIL
QC Lot: 03 JUN 96-N1
Concentration Units: mg/kg

Gasoline Range Organics	5.00	4.32	4.14	4.23	85	63-111	4.3	10
a,a,a-Trifluorotoluene	1.50	1.56	1.55	1.56	104	75-125	0.90*	0

* = RPD outside QC Limits

Calculations are performed before rounding to avoid round-off errors in calculated results.

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
049298-0001-FB	AQUEOUS	8020-A	05 JUN 96-P	05 JUN 96-P
049298-0002-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0002-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0002-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0003-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0003-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0003-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0004-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0004-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0004-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0005-SA	SOIL	8020-S	03 JUN 96-N1	03 JUN 96-N1
049298-0005-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0005-SA	SOIL	8020-S	03 JUN 96-N1	03 JUN 96-N1
049298-0006-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0006-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0006-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0007-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0007-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0007-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0008-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0008-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0008-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0009-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0009-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0009-MS	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0009-MS	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0009-SD	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0009-SD	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0010-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0010-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1
049298-0010-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H
049298-0011-TB	AQUEOUS	8020-A	05 JUN 96-P	05 JUN 96-P

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science
CID: RB
Lab ID: 049298-0012-RB
Matrix: WATER-QA
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: 31 MAY 96
Analyzed: 05 JUN 96

Parameter	Result	Units	Reporting Limit
Diesel Range Organics	ND	mg/L	0.10
Surrogate	Recovery		Limits
o-Terphenyl	88	%	47-137

Dilution factor is 1.0.

All results and limits are corrected for dilution.

= Not Detected

Reported By: Don Vieaux

Approved By: Audrey Cornell

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science
Client ID: 49BH09-14.5
Lab ID: 049298-0010-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: 10 JUN 96
Analyzed: 13 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit
Diesel Range Organics	ND	mg/kg	4.2
Surrogate	Recovery		Limits
o-Terphenyl	103	%	64-136

Percent moisture is 5.5%.
Dilution factor is 1.0.

All results and limits are reported on a dry weight basis.
All results and limits are corrected for dilution.

ND = Not Detected

Reported By: Bret Collins

Approved By: Audrey Cornell

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science
Client ID: 49BH09-13
Lab ID: 049298-0009-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: 10 JUN 96
Analyzed: 13 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Diesel Range Organics	3.4	mg/kg	4.1	J
Surrogate	Recovery		Limits	
o-Terphenyl	104	%	64-136	

Percent moisture is 2.3%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

Result is detected below the reporting limit or is an estimated concentration.

Reported By: Bret Collins

Approved By: Audrey Cornell

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science
Client ID: 49BH06-21.5
Lab ID: 049298-0008-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: 10 JUN 96
Analyzed: 13 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Diesel Range Organics	23	mg/kg	4.4	q1
Surrogate	Recovery		Limits	
o-Terphenyl	101	%	64-136	

Percent moisture is 8.8%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

1 = Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.
q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Bret Collins

Approved By: Audrey Cornell

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science
CT ID: 49BH06-11.5
Lab ID: 049298-0007-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: 10 JUN 96
Analyzed: 13 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Diesel Range Organics	37	mg/kg	4.3	ql
Surrogate	Recovery		Limits	
o-Terphenyl	101	%	64-136	

Percent moisture is 7.9%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

1 = Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.
= This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Bret Collins

Approved By: Audrey Cornell

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science

Client ID: 49BH06-9.5

Lab ID: 049298-0006-SA

Matrix: SOIL

Authorized: 30 MAY 96

Sampled: 28 MAY 96

Received: 30 MAY 96

Prepared: 10 JUN 96

Analyzed: 14 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Diesel Range Organics	50	mg/kg	4.1	q1
Surrogate	Recovery		Limits	
o-Terphenyl	101	%	64-136	

Percent moisture is 3.5%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

1 = Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.
q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Bret Collins

Approved By: Audrey Cornell

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science
Contract ID: 49BH07-12
Laboratory: 049298-0005-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: 10 JUN 96
Analyzed: 14 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Diesel Range Organics	930	mg/kg	43	1
Surrogate	Recovery		Limits	
o-Terphenyl	ND	%	64-136	

Percent moisture is 7.9%. All results and limits are reported on a dry weight basis.
Dilution factor is 10. All results and limits are corrected for dilution.

1 = Qualitative ID: This sample has GC/FID characteristics that are similar to JP4. Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.
Not Detected

Reported By: Bret Collins

Approved By: Audrey Cornell

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science
Client ID: 49BH07-10.5
Lab ID: 049298-0004-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: 10 JUN 96
Analyzed: 14 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Diesel Range Organics	24	mg/kg	4.1	ql
Surrogate	Recovery		Limits	
o-Terphenyl	99	%	64-136	

Percent moisture is 3.3%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

1 = Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.
q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Bret Collins

Approved By: Audrey Cornell

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science
Contract ID: 49BH08-13
Lab ID: 049298-0003-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: 10 JUN 96
Analyzed: 14 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Diesel Range Organics	500	mg/kg	18	q1
Surrogate	Recovery		Limits	
o-Terphenyl	100	%	64-136	

Percent moisture is 10.1%. All results and limits are reported on a dry weight basis.
Dilution factor is 4.0. All results and limits are corrected for dilution.

- 1 = Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.
= This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Bret Collins

Approved By: Audrey Cornell

AFCEE^ Extractable Petroleum Hydrocarbons
Method 8015 Modified



Client Name: Parsons Engineering Science
Client ID: 49BH08-11.5
Lab ID: 049298-0002-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: 10 JUN 96
Analyzed: 13 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Diesel Range Organics	12	mg/kg	4.2	q1
Surrogate	Recovery		Limits	
o-Terphenyl	92	%	64-136	

Percent moisture is 4.4%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

1 = Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C28.
q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Bret Collins

Approved By: Audrey Cornell

AFCEE^Gasoline Range Organics
Method 8015 Modified



Name: Parsons Engineering Science
ID: 49BH09-14.5
Lab ID: 049298-0010-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Gasoline Range Organics	0.39	mg/kg	1.3	JBq
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	85	%	75-125	

Percent moisture is 5.5%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.
J = Result is detected below the reporting limit or is an estimated concentration.
= This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Kenneth Aten

Approved By: Karen Kuiken

AFCEE^Gasoline Range Organics
Method 8015 Modified



Client Name: Parsons Engineering Science
Client ID: 49BH09-13
Lab ID: 049298-0009-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Gasoline Range Organics	0.69	mg/kg	1.3	JBq
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	94	%	75-125	

Percent moisture is 2.3%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.

J = Result is detected below the reporting limit or is an estimated concentration.

q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Kenneth Aten

Approved By: Karen Kuiken

AFCEE^Gasoline Range Organics
Method 8015 Modified



Client Name: Parsons Engineering Science
CIVIL ID: 49BH06-21.5
Lab: 049298-0008-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Gasoline Range Organics	2.7	mg/kg	1.4	Bq
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	92	%	75-125	

Percent moisture is 8.8%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.

This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Kenneth Aten

Approved By: Karen Kuiken

AFCEE Gasoline Range Organics
Method 8015 Modified



Client Name: Parsons Engineering Science

Client ID: 49BH06-11.5

Lab ID: 049298-0007-SA

Matrix: SOIL

Authorized: 30 MAY 96

Sampled: 28 MAY 96

Received: 30 MAY 96

Prepared: NA

Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Gasoline Range Organics	22	mg/kg	1.4	Bq
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	97	%	75-125	

Percent moisture is 7.9%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.

q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Kenneth Aten

Approved By: Karen Kuiken

AFCEE^Gasoline Range Organics
Method 8015 Modified



Client Name: Parsons Engineering Science
CID: 49BH06-9.5
Lab ID: 049298-0006-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 05 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Gasoline Range Organics	32	mg/kg	1.3	Bq
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	96	%	75-125	

Percent moisture is 3.5%. All results and limits are reported on a dry weight basis.
Dilution factor is 1.0. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.
This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Kenneth Aten

Approved By: Karen Kuiken

AFCEE^Gasoline Range Organics
Method 8015 Modified



Client Name: Parsons Engineering Science
Client ID: 49BH07-12
Lab ID: 049298-0005-SA
Matrix: SOIL
Authorized: 30 MAY 96

Sampled: 28 MAY 96
Received: 30 MAY 96

Prepared: NA
Analyzed: 06 JUN 96

Parameter	Result	Dry Weight Units	Reporting Limit	
Gasoline Range Organics	1600	mg/kg	140	Bq
Surrogate	Recovery		Limits	
a,a,a-Trifluorotoluene	ND	%	75-125	

Percent moisture is 7.9%. All results and limits are reported on a dry weight basis.
Dilution factor is 100. All results and limits are corrected for dilution.

B = Compound is also detected in the blank.

q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

ND = Not Detected

Reported By: Kenneth Aten

Approved By: Karen Kuiken

DUPLICATE CONTROL SAMPLE REPORT
Organics by Chromatography (cont.)

Analyte	Spiked	Concentration		Measured DCS2	AVG	Accuracy Average(%)		Precision (RPD)	
		DCS1				DCS	Limits	DCS	Limits
Category: 8020-S									
Matrix: SOIL									
QC Lot: 03 JUN 96-N1									
Concentration Units: ug/kg									
Benzene	1000	835		881	858	86	73-123	5.4	10
Toluene	1000	866		912	889	89	79-118	5.2	10
Chlorobenzene	1000	895		953	924	92	82-116	6.3	10
Ethylbenzene	1000	889		930	910	91	82-116	4.5	10
Xylenes (total)	3000	2660		2830	2740	92	81-116	6.3	10
1,3-Dichlorobenzene	1000	893		956	924	92	81-122	6.8	10
1,4-Dichlorobenzene	1000	907		971	939	94	82-116	6.8	10
1,2-Dichlorobenzene	1000	871		936	904	90	82-114	7.2	10

Calculations are performed before rounding to avoid round-off errors in calculated results.

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	SCS	Limits

Category: 8020-A

Matrix: AQUEOUS

QC Lot: 05 JUN 96-P QC Run: 05 JUN 96-P

Concentration Units: ug/L

a,a,a-Trifluorotoluene	30.0	27.6	92	77-115
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Category: 8020-SL

Matrix: SOIL

QC Lot: 04 JUN 96-H QC Run: 04 JUN 96-H

Concentration Units: ug/kg

a,a,a-Trifluorotoluene	75.0	71.1	95	70-130
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Category: 8015G-AF-S

Matrix: SOIL

QC Lot: 03 JUN 96-N1 QC Run: 03 JUN 96-N1

Concentration Units: mg/kg

a,a,a-Trifluorotoluene	1.50	1.45	97	75-125
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Category: 8020-S

Matrix: SOIL

QC Lot: 03 JUN 96-N1 QC Run: 03 JUN 96-N1

Concentration Units: ug/kg

a,a,a-Trifluorotoluene	1500	1400	93	82-114
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Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Organics by Chromatography

Analyte	Result	Units	Reporting Limit	
Test: 8020-BTEX-AP				
Matrix: WATER-QA				
QC Lot: 05 JUN 96-P QC Run: 05 JUN 96-P				
Benzene	ND	ug/L	0.50	
Toluene	ND	ug/L	0.50	
Ethylbenzene	ND	ug/L	0.50	
Xylenes (total)	ND	ug/L	0.50	
Test: 8020L-BTEX-S				
Matrix: SOIL				
QC Lot: 04 JUN 96-H QC Run: 04 JUN 96-H				
Benzene	ND	ug/kg	5.0	
Toluene	ND	ug/kg	5.0	
Ethylbenzene	ND	ug/kg	5.0	
Xylenes (total)	ND	ug/kg	5.0	
Test: 8015M-GRO-AFCEE-S				
Matrix: SOIL				
QC Lot: 03 JUN 96-N1 QC Run: 03 JUN 96-N1				
Line Range Organics	0.46	mg/kg	1.2	J
Test: 8020L-BTEX-2-S				
Matrix: SOIL				
QC Lot: 04 JUN 96-H QC Run: 04 JUN 96-H				
Benzene	ND	ug/kg	5.0	
Toluene	ND	ug/kg	5.0	
Ethylbenzene	ND	ug/kg	5.0	
Xylenes (total)	ND	ug/kg	5.0	
Test: 8020-BTEX-S				
Matrix: SOIL				
QC Lot: 03 JUN 96-N1 QC Run: 03 JUN 96-N1				
Benzene	ND	ug/kg	50	
Toluene	ND	ug/kg	50	
Ethylbenzene	ND	ug/kg	50	
Xylenes (total)	ND	ug/kg	50	

J = Result is detected below the reporting limit or is an estimated concentration.

METHOD BLANK REPORT
Organics by Chromatography (cont.)

Analyte	Result	Units	Reporting Limit
Test: 8020-BTEX-2-S			
Matrix: SOIL			
QC Lot: 03 JUN 96-N1 QC Run: 03 JUN 96-N1			
Benzene	ND	ug/kg	50
Toluene	ND	ug/kg	50
Ethylbenzene	ND	ug/kg	50
Xylenes (total)	ND	ug/kg	50

Test: 8020L-BTEX-S			
Matrix: SOIL			
QC Lot: 04 JUN 96-H QC Run: 04 JUN 96-H			
Benzene	ND	ug/kg	5.0
Toluene	ND	ug/kg	5.0
Ethylbenzene	ND	ug/kg	5.0
Xylenes (total)	ND	ug/kg	5.0

Test: 8015M-GRO-AFCEE-S			
Matrix: SOIL			
QC Lot: 03 JUN 96-N1 QC Run: 03 JUN 96-N1			
Gasoline Range Organics	0.46	mg/kg	1.2 J

J = Result is detected below the reporting limit or is an estimated concentration.

LOT ASSIGNMENT REPORT - MS QC
 Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)	MS QC Run Number (SA,MS,SD,DU)
049298-0001-FB	AQUEOUS	8020-A	05 JUN 96-P	05 JUN 96-P	05 JUN 96-P
049298-0002-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0002-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0003-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0003-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0004-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0004-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0005-SA	SOIL	8020-S	03 JUN 96-N1	03 JUN 96-N1	
049298-0005-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0006-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0006-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0007-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0007-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0008-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0008-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0009-MS	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0009-MS	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0009-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0009-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0009-SD	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0009-SD	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0010-SA	SOIL	8020-SL	04 JUN 96-H	04 JUN 96-H	04 JUN 96-H
049298-0010-SA	SOIL	8015G-AF-S	03 JUN 96-N1	03 JUN 96-N1	03 JUN 96-N1
049298-0011-TB	AQUEOUS	8020-A	05 JUN 96-P	05 JUN 96-P	05 JUN 96-P

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Organics by Chromatography
Project: 049298

Category: 8020-SL Direct Purge Soils
Matrix: SOIL
Sample: 049298-0009
S Run: 04 JUN 96-H
Units ug/kg Units Qualifier: Dry weight

Analyte	Sample Result	Concentration		Amount Spiked		% Recovery		Recov. Accep.	RPD	RPD Accept
		MS Result	MSD Result	MS	MSD	MS	MSD	Limits	MS-MSD	Limits
Benzene	ND	51	51	51	51	99	100	39-150	0.4	25
Toluene	ND	50	50	51	51	97	97	46-148	0.6	25
Chlorobenzene	NA	NA	NA	51	51	NC	NC	55-135	0.0	25
Ethylbenzene	ND	51	49	51	51	99	95	32-160	3.9	25
Arylenes (total)	ND	150	150	150	150	99	96	65-135	2.7	25
1,3-Dichlorobenzene	NA	NA	NA	51	51	NC	NC	50-141	0.0	25
1,4-Dichlorobenzene	NA	NA	NA	51	51	NC	NC	42-143	0.0	25
1,2-Dichlorobenzene	NA	NA	NA	51	51	NC	NC	37-154	0.0	25

Category: 8015G-AF-S Gasoline Range Organics, AFCEE
Matrix: SOIL
Sample: 049298-0009
S Run: 03 JUN 96-N1
Units mg/kg Units Qualifier: Dry Weight

Analyte	Sample Result	Concentration		Amount Spiked		% Recovery		Recov. Accep.	RPD	RPD Accept
		MS Result	MSD Result	MS	MSD	MS	MSD	Limits	MS-MSD	Limits
Gasoline Range Organics	ND	3.4	3.6	5.1	5.1	66	70	63-111	6.9	10
1,1,1-Trifluorotoluene	96	95	96	0.0	0.0	NC	NC	75-125	1.2	0
Surrogates		%Recovery		Rec. Accept. Limits						

A = Not Applicable
C = Not Calculated, calculation not applicable.
D = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

IX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
 Quanterra by Chromatography
 Project: 049298 (cont.)

Category: 8020-A Method 8020 Aromatic Volatile Organics
 Matrix: AQUEOUS
 Sample: 049360-0001
 MS Run: 05 JUN 96-P
 Units: ug/L

Analyte	Sample Result	Concentration		Amount Spiked		% Recovery		Recov. Accep.		RPD Accept	
		MS Result	MSD Result	MS	MSD	MS	MSD	Limits	MS-MSD	Limits	
Benzene	ND	18	18	20	20	88	92	39-150	5.0	20	
Toluene	ND	18	19	20	20	88	93	46-148	5.0	20	
Chlorobenzene	ND	18	19	20	20	90	96	55-135	5.4	20	
Ethylbenzene	ND	18	19	20	20	92	97	32-160	4.7	20	
Xylenes (total)	ND	55	58	60	60	91	97	65-135	5.6	20	
1,3-Dichlorobenzene	ND	18	19	20	20	89	95	50-141	6.5	20	
1,4-Dichlorobenzene	ND	18	19	20	20	90	96	42-143	6.5	20	
1,2-Dichlorobenzene	9.1	26	27	20	20	86	91	37-154	4.1	20	

ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

QC LOT ASSIGNMENT REPORT
 Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
049298-0002-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0003-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0004-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0005-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0006-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0007-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0008-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0009-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0009-MS	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0009-SD	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0010-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01
049298-0012-RB	AQUEOUS	8015D-AF-A	31 MAY 96-N1	31 MAY 96-N1

DUPLICATE CONTROL SAMPLE REPORT
Semi-volatile Organics by GC

Analyte	Spiked	Concentration		Measured DCS2	AVG	Accuracy Average(%)		Precision (RPD)	
		DCS1				DCS	Limits	DCS	Limits

Category: 8015D-AF-S
Matrix: SOIL
QC Lot: 10 JUN 96-01
Concentration Units: mg/kg

Diesel Range Organics	20.0	19.4	18.6	19.0	95	48-138	4.3	32
o-Terphenyl	0.800	0.822	0.779	0.800	100	64-136	5.4	

Category: 8015D-AF-A
Matrix: AQUEOUS
QC Lot: 31 MAY 96-N1
Concentration Units: mg/L

Diesel Range Organics	0.500	0.252	0.193	0.223	45	26-121	26	44
o-Terphenyl	0.0200	0.0174	0.0186	0.0180	90	47-137	6.7	

* = RPD outside QC Limits

Calculations are performed before rounding to avoid round-off errors in calculated results.

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	SCS	Limits

Category: 8015D-AF-S

Matrix: SOIL

QC Lot: 10 JUN 96-01 QC Run: 10 JUN 96-01

Concentration Units: mg/kg

o-Terphenyl	0.800	0.800	100	64-136
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Category: 8015D-AF-A

Matrix: AQUEOUS

QC Lot: 31 MAY 96-N1 QC Run: 31 MAY 96-N1

Concentration Units: mg/L

o-Terphenyl	0.0200	0.0166	83	47-137
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Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Semi-volatile Organics by GC

Analyte	Result	Units	Reporting Limit
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Test: 8015M-DRO-AFCEE-S

Matrix: SOIL

QC Lot: 10 JUN 96-01 QC Run: 10 JUN 96-01

Diesel Range Organics	ND	mg/kg	4.0
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Test: 8015M-DRO-AFCEE-S

Matrix: SOIL

QC Lot: 10 JUN 96-01 QC Run: 10 JUN 96-01

Diesel Range Organics	ND	mg/kg	4.0
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Test: 8015M-DRO-AFCEE-A

Matrix: WATER-QA

QC Lot: 31 MAY 96-N1 QC Run: 31 MAY 96-N1

Diesel Range Organics	ND	mg/L	0.10
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QC LOT ASSIGNMENT REPORT - MS QC
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)	MS QC Run Number (SA,MS,SD,DU)
049298-0002-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0003-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0004-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0005-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0006-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0007-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0008-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0009-MS	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0009-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0009-SD	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0010-SA	SOIL	8015D-AF-S	10 JUN 96-01	10 JUN 96-01	10 JUN 96-01
049298-0012-RB	AQUEOUS	8015D-AF-A	31 MAY 96-N1	31 MAY 96-N1	

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT

Semi-volatile Organics by GC

Project: 049298

Category: 8015D-AF-S Diesel Range Organics in Solid Samples, AFCEE

Matrix: SOIL

Sample: 049298-0009

MS Run: 10 JUN 96-01

Units mg/kg Units Qualifier: Dry Weight

Analyte	Sample Result		Concentration		Amount Spiked		% Recovery		Recov. Accep.		RPD Accept	
			MS Result	MSD Result	MS	MSD	MS	MSD	Limits	MS-MSD	Limits	Limits
Diesel Range Organics	3.4	Jq	20	23	20	20	83	94	48-138	9.6	32	
o-Terphenyl	110		100	110	0.0	0.0	NC	NC	64-136	5.7		

J = Result is detected below the reporting limit or is an estimated concentration.
q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.
NC = Not Calculated, calculation not applicable.

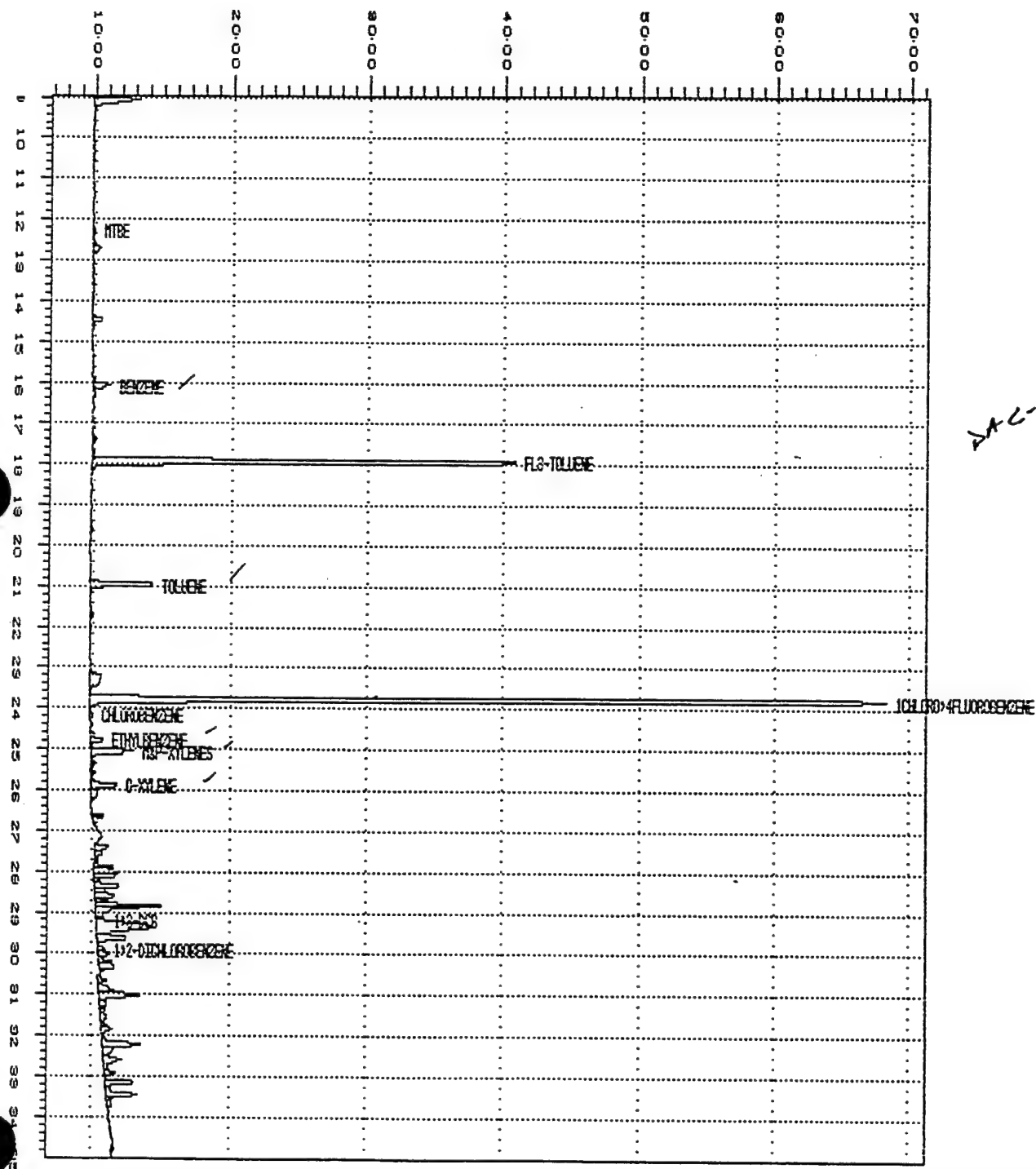
Calculations are performed before rounding to avoid round-off errors in calculated results.



Quanterra Denver Multichrom V2.1

[VOA06_1] 16 H04JUN96,8,1

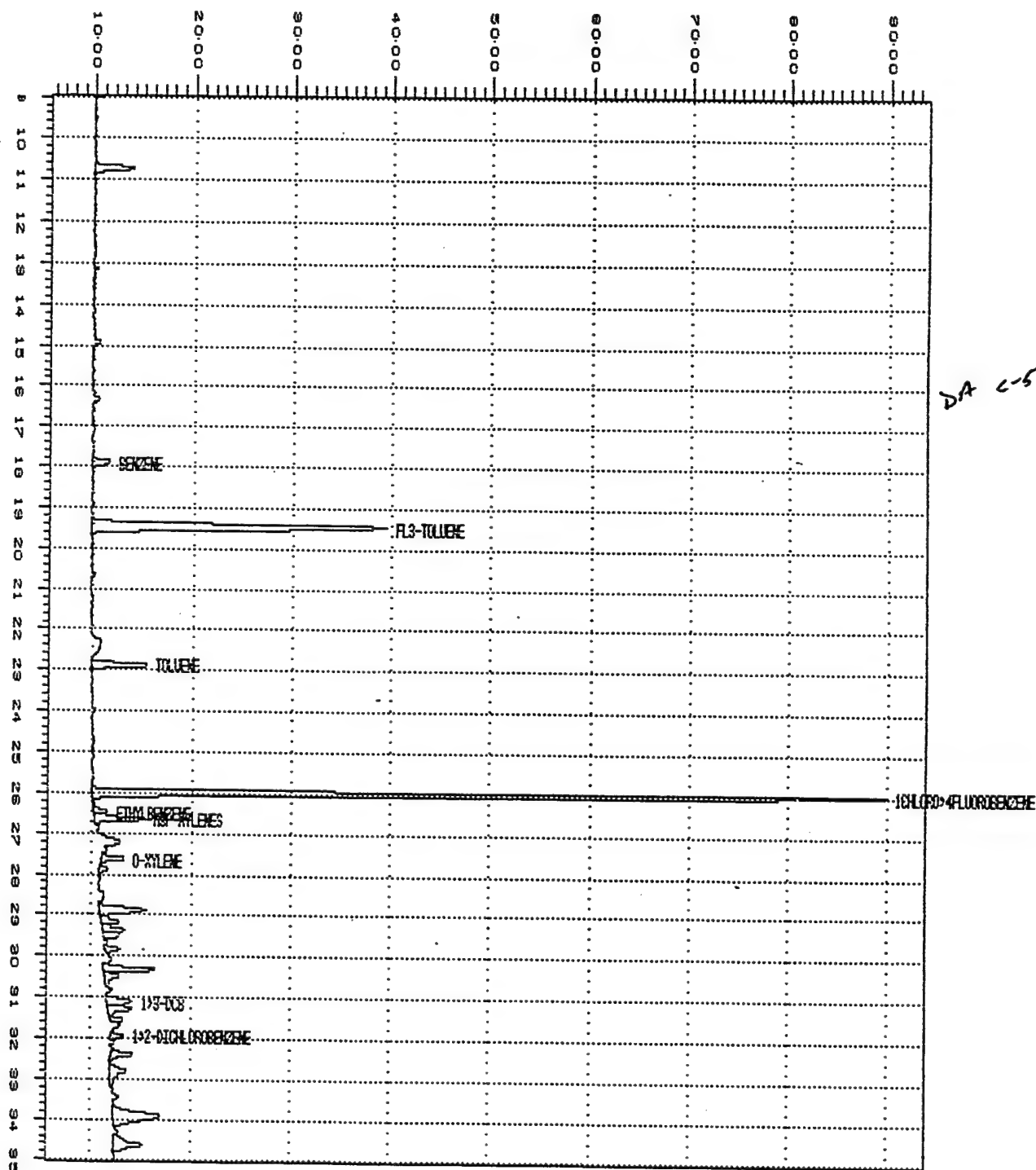
49298-02 PDIL=100% T=SA. Amount : 1.000.
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 Acquired on 4-JUN-1996 at 16:45
 Reported on 4-JUN-1996 at 17:22
 Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VDA06_1] 15 H04JUN96,8,1

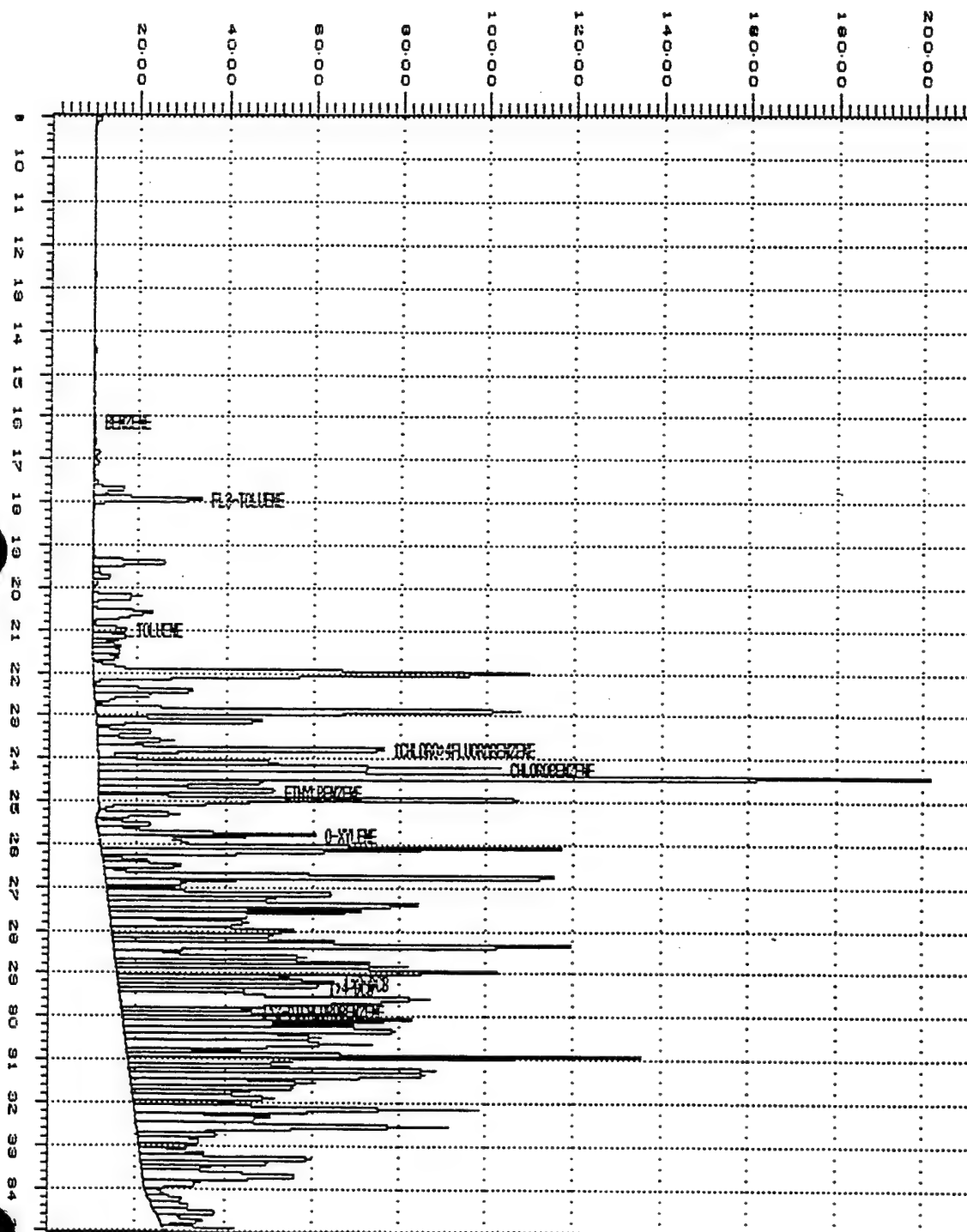
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Acquired on 4-JUN-1996 at 16:45
Reported on 4-JUN-1996 at 17:22
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VDA06_1] 16 H04JUN96,9,1

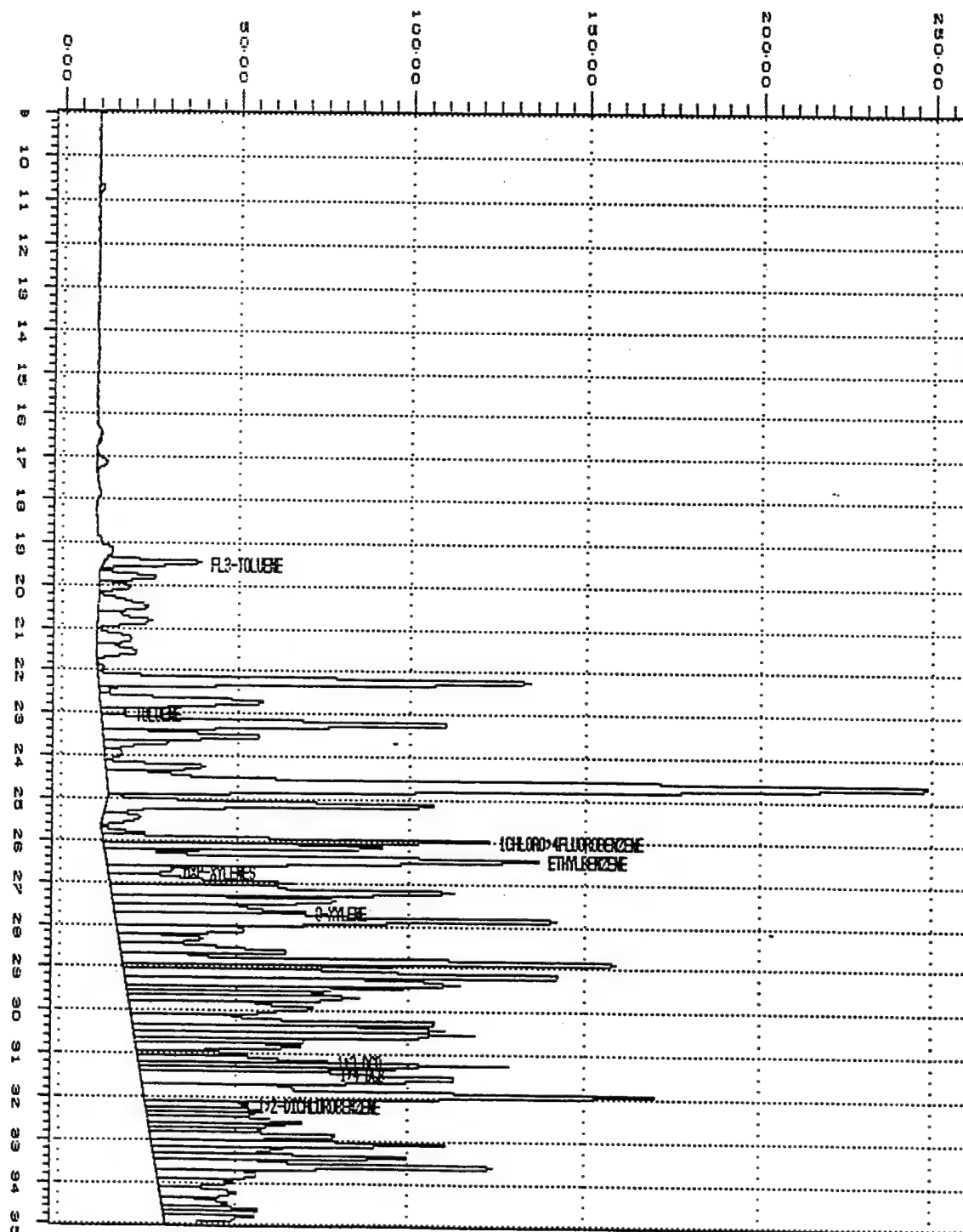
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 Acquired on 4-JUN-1996 at 17:29
 Reported on 4-JUN-1996 at 18:07
 Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VDA06_1] 15 H04JUN96,9,1

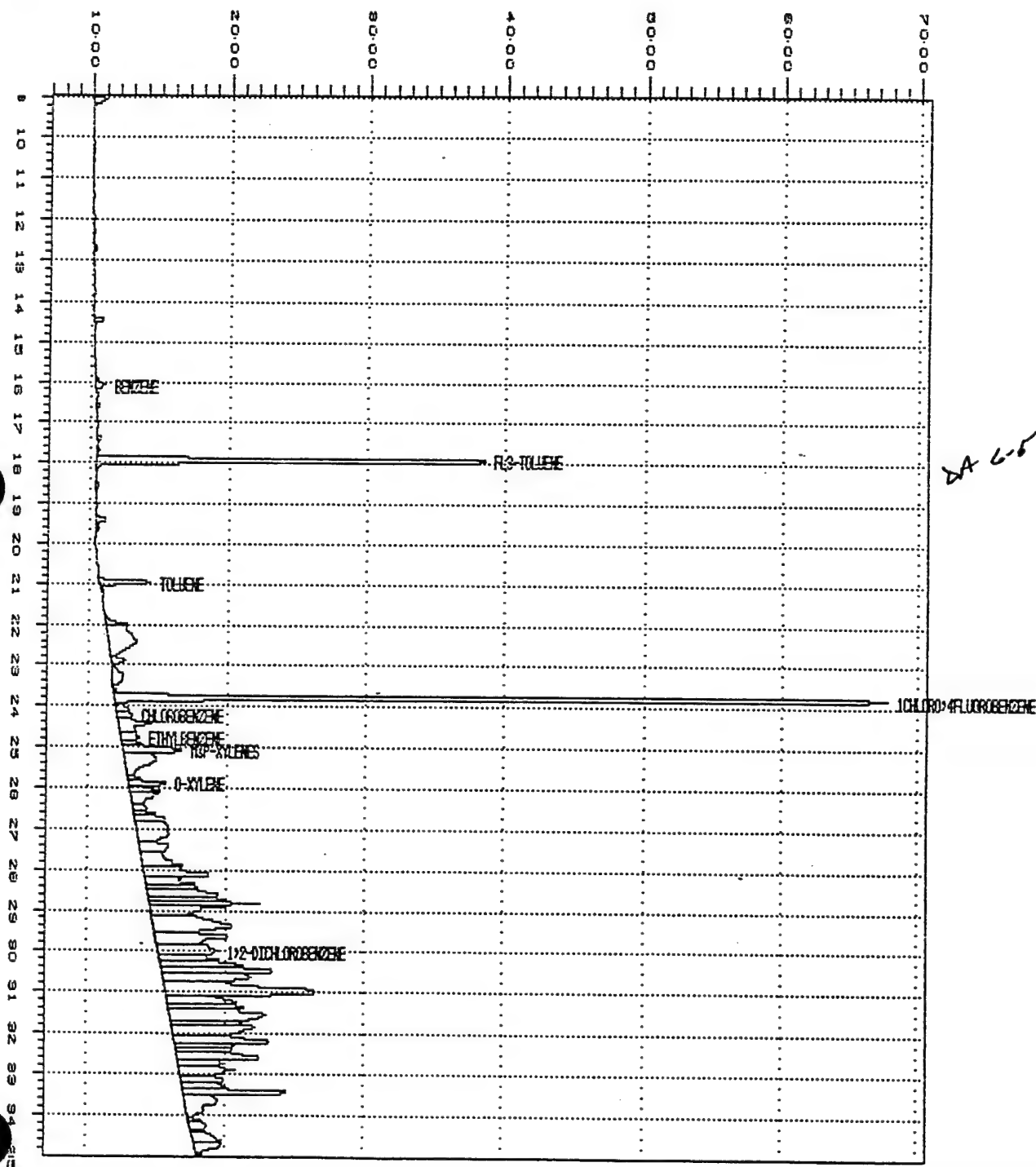
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Acquired on 4-JUN-1996 at 17:29
Reported on 4-JUN-1996 at 18:07
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[V0A06_1] 16 H04JUN96,10,1

49298-04 PDIL=100% T=SA. Amount : 1.000.
 HP5890 INSTRUMENT 'H' PID RTx-1 60m. x 0.53ID. x 3.0um
 Acquired on 4-JUN-1996 at 18:13
 Reported on 4-JUN-1996 at 18:51
 Box 1 (of 1)



DA 6.5

Quanterra Denver Multichrom V2.1

[VOA06_2] 16 H10JUN96,5,1

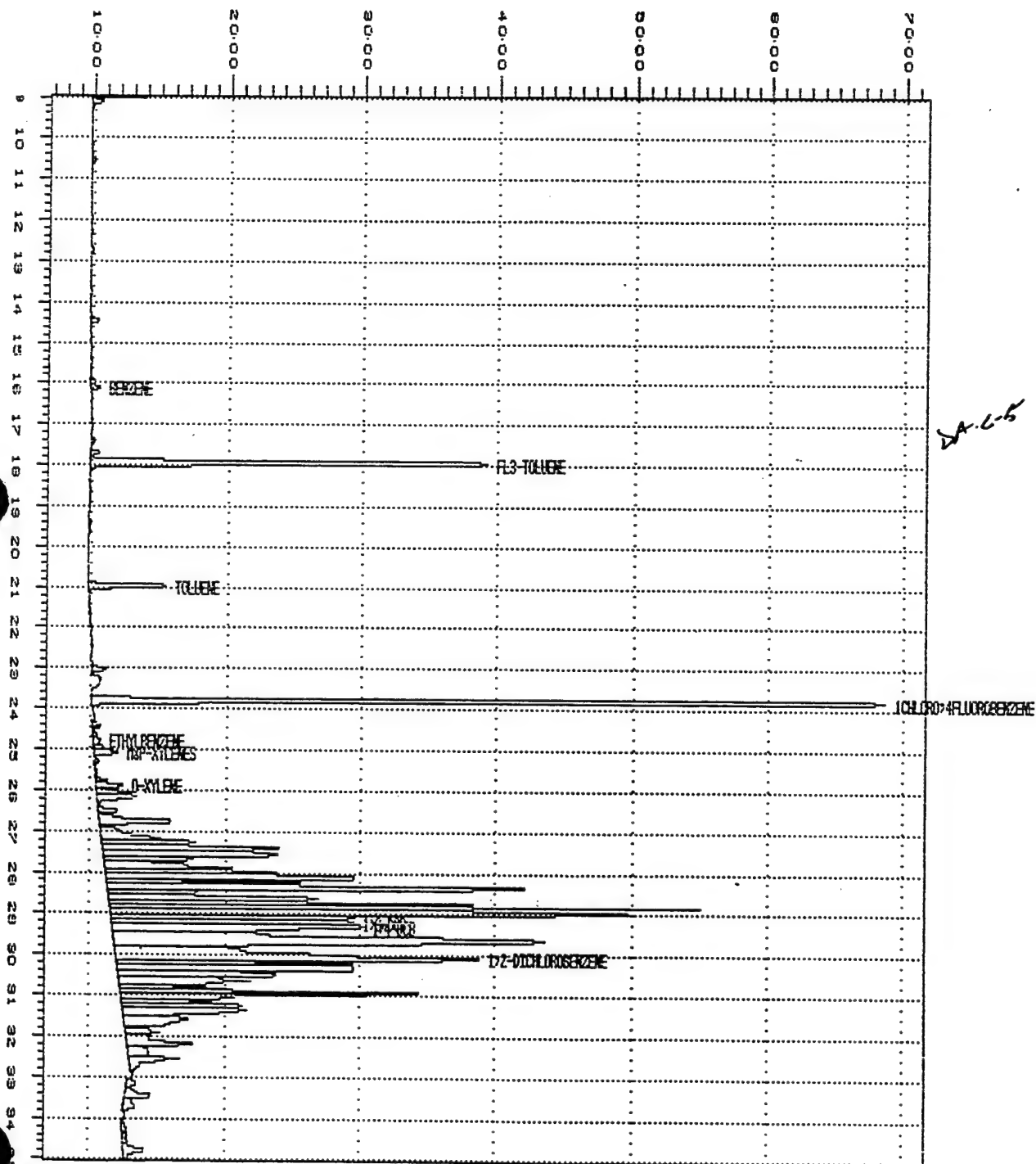
49298-03 PDIL=10% T=SA. Amount : 1.000.
INSTRUMENT "H" RTx-1 105M. x 0.53mm ID x 3.0um Film
Acquired on 10-JUN-1996 at 13:16
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Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VOA06_1] 16 H04JUN96,15,1

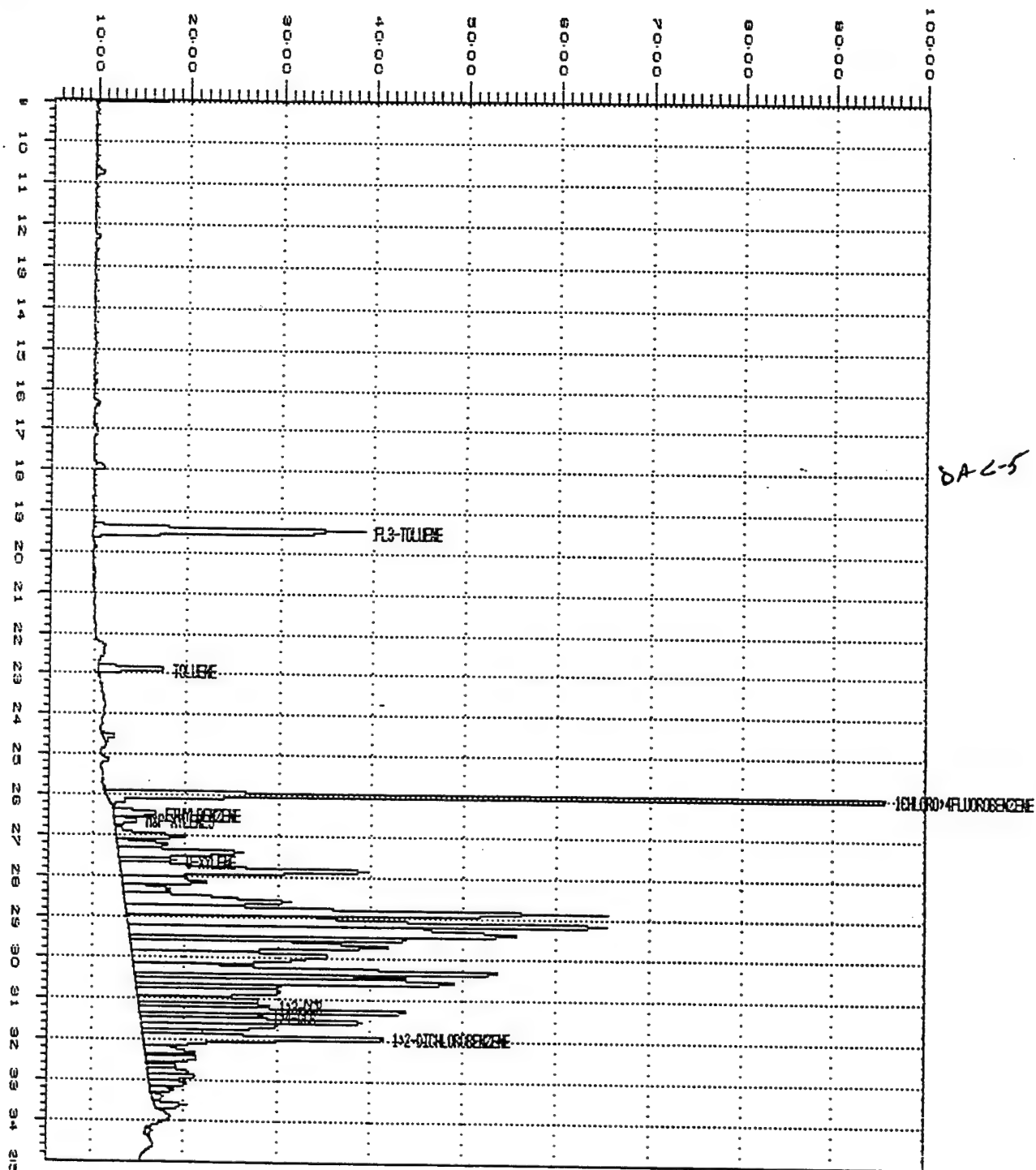
49298-06 PDIL=100% T=SA RU=MG/KG. Amount : 1.000.
HP5890 INSTRUMENT 'H' PID RTx-1 60m. x 0.53ID. x 3.0um
Acquired on 4-JUN-1996 at 22:26
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Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VOA06_1] 15 H04JUN96,15,1

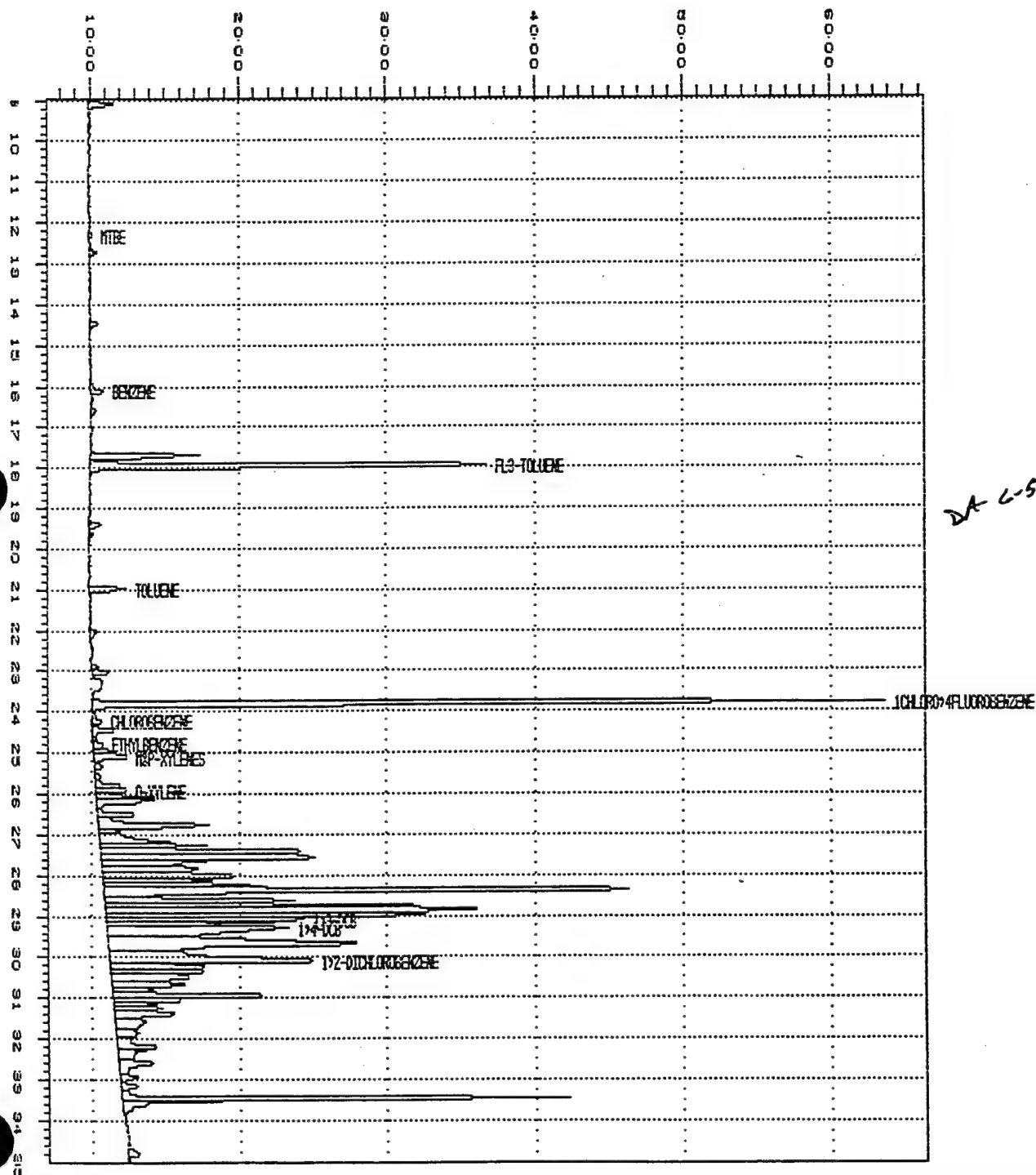
49298-06 PDIL=100% T=SA RU=MG/KG. Amount : 1.000.
HP5890 INSTRUMENT 'H' PID RTx-502.2 105m. x 0.53ID. x 3.0um
Acquired on 4-JUN-1996 at 22:26
Reported on 4-JUN-1996 at 23:04
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VOAS6_1] 16 H04JUN96,16,1

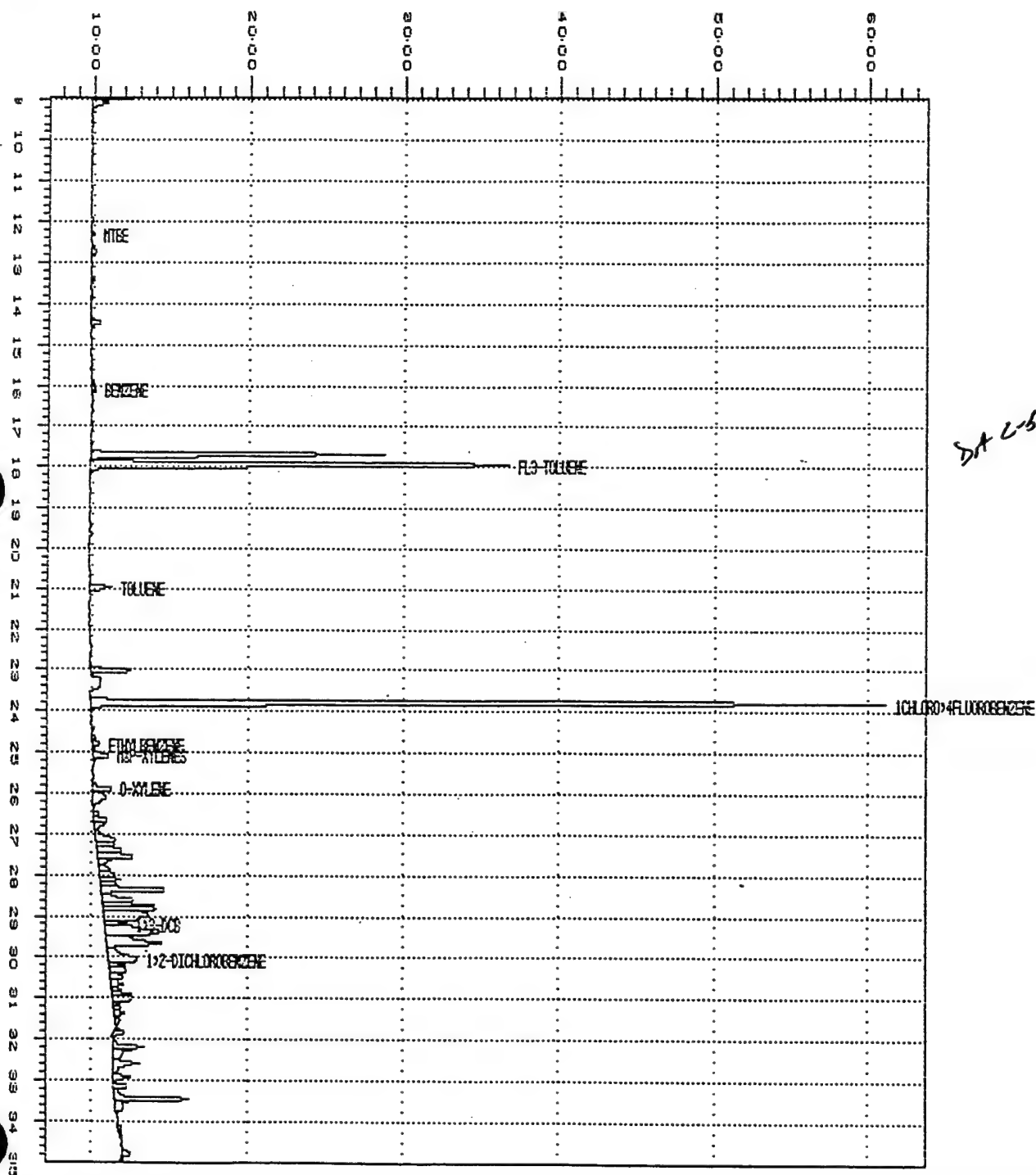
49298-07 PDIL=100% T=SA RU=MG/KG. Amount : 1.000.
 HF5890 INSTRUMENT 'H' PID RTx-1 60m. x 0.53ID. x 3.0um
 Acquired on 4-JUN-1996 at 23:10
 Reported on 4-JUN-1996 at 23:48
 Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VDA06_1] 16 H04JUN96,17,1

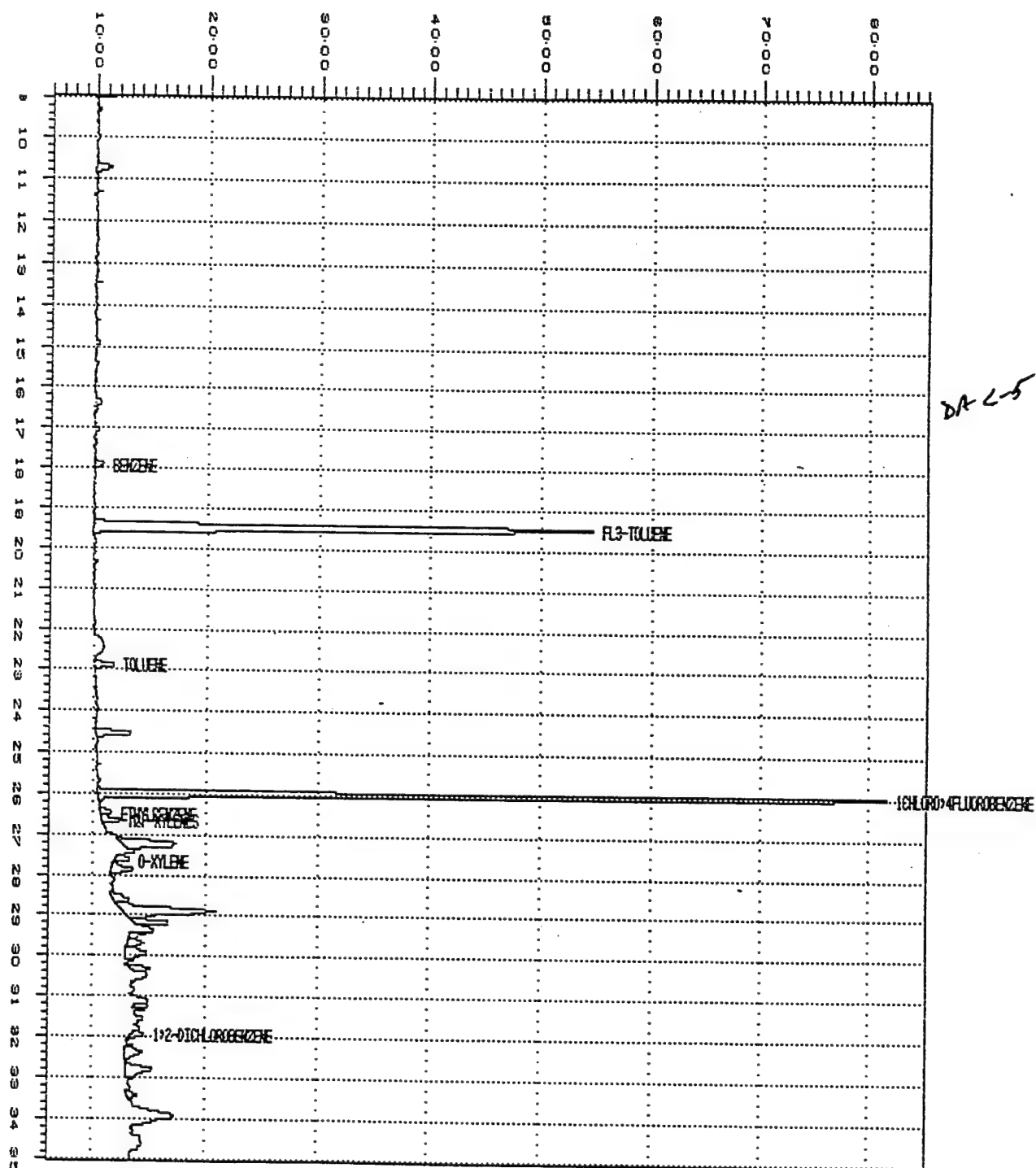
49298-08 PDIL=100% T=SA RU=MG/KG. Amount : 1.000.
 HP5890 INSTRUMENT 'H' PID RTx-1 60m. x 0.53ID. x 3.0um
 Acquired on 4-JUN-1996 at 23:54
 Reported on 5-JUN-1996 at 00:32
 Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VDA06_1] 15 H04JUN96,17,1

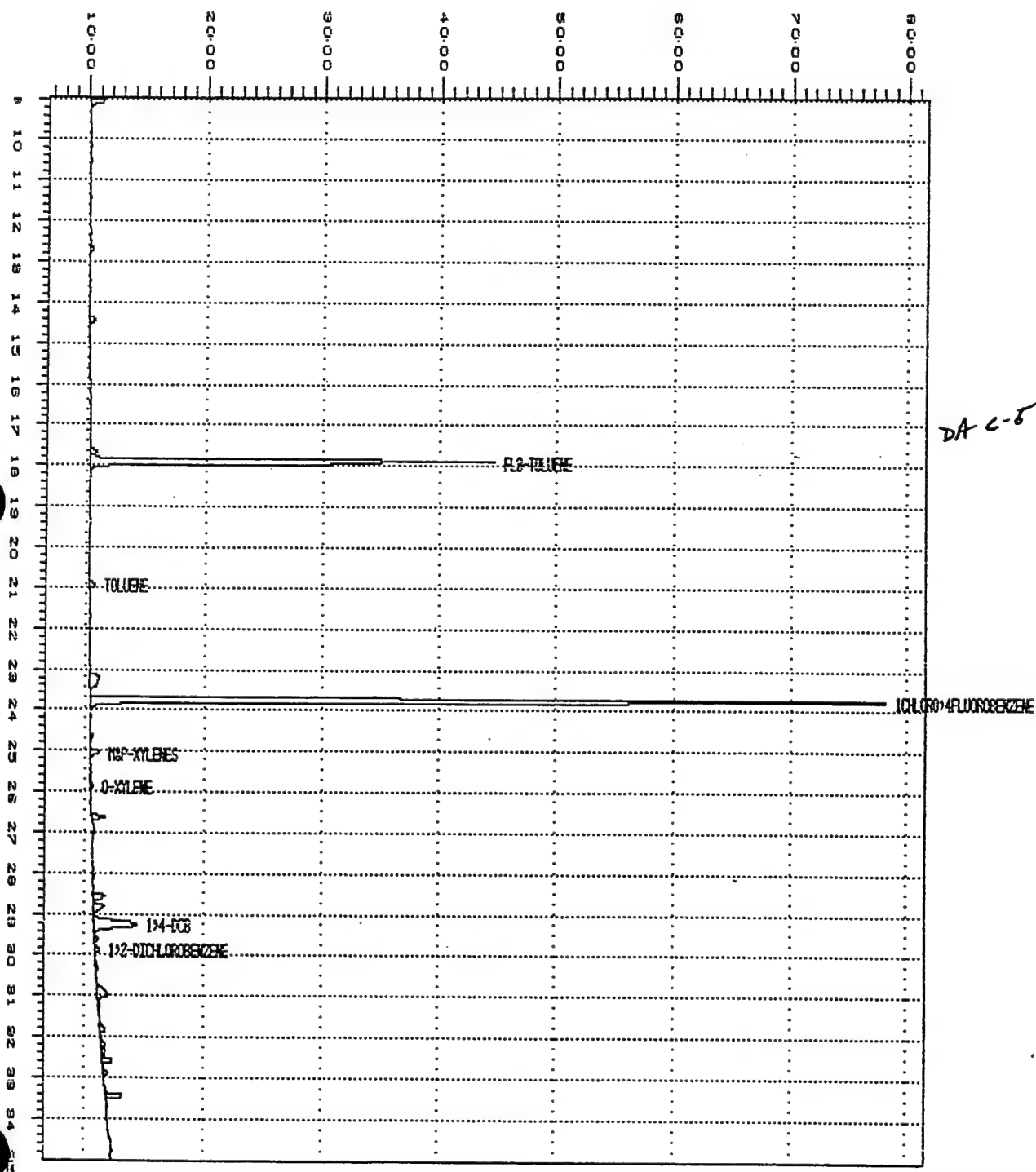
49298-08 PDIL=100% T=SA RU=MG/KG. Amount : 1.000.
HP5890 INSTRUMENT 'H' PID RTx-502.2 105m. x 0.53ID. x 3.0um
Acquired on 4-JUN-1996 at 23:54
Reported on 5-JUN-1996 at 00:32
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

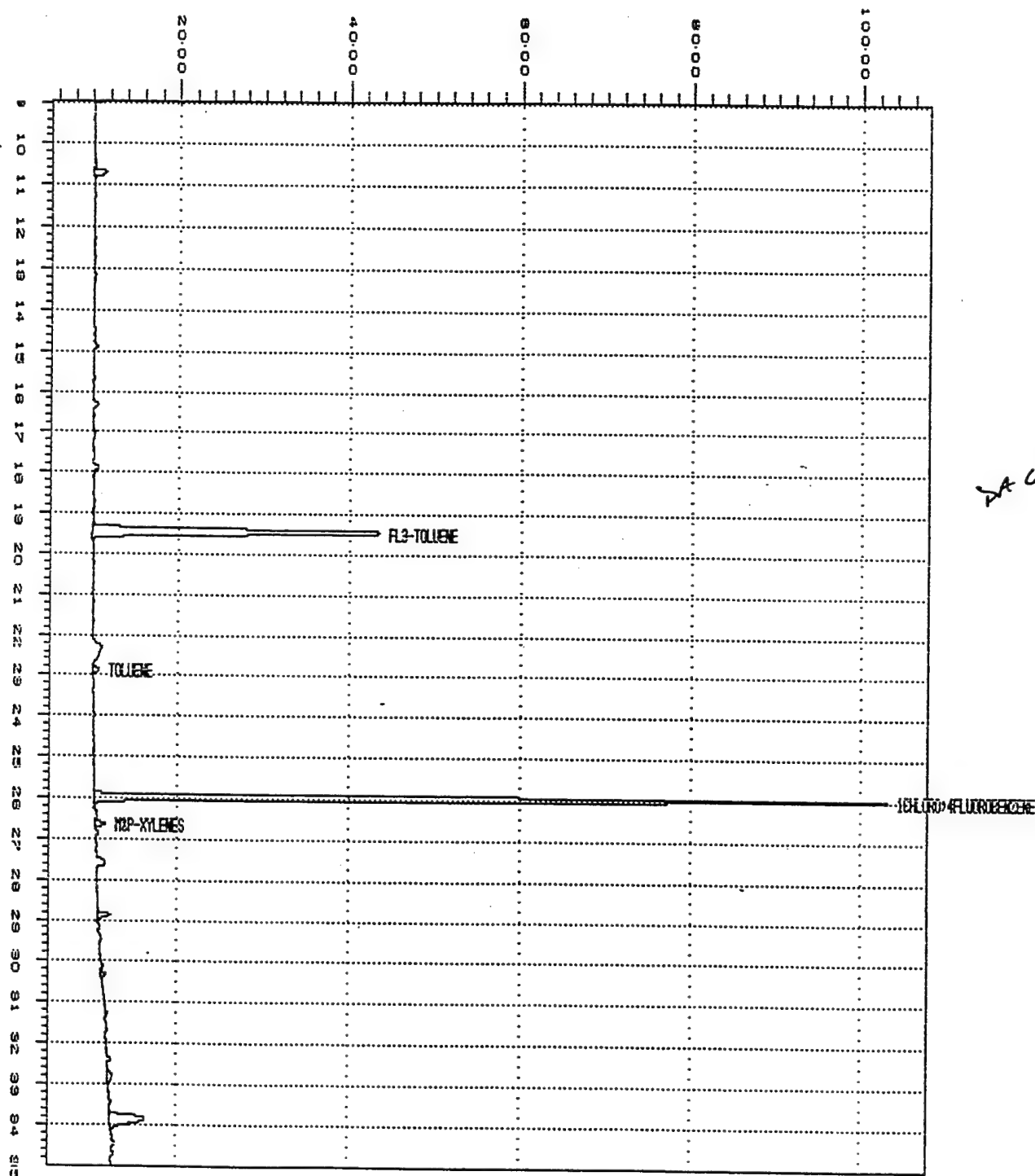
[VDA06_1] 16 H04JUN96,5,1

49298-09 PDIL=100% T=SA. Amount : 1.000.
HP5890 INSTRUMENT 'H' PID RTx-1 60m. x 0.53ID. x 3.0um
Acquired on 4-JUN-1996 at 14:32
Reported on 4-JUN-1996 at 15:10
Box 1 (of 1)



[VOA06_1] 15 H04JUN96,5,1

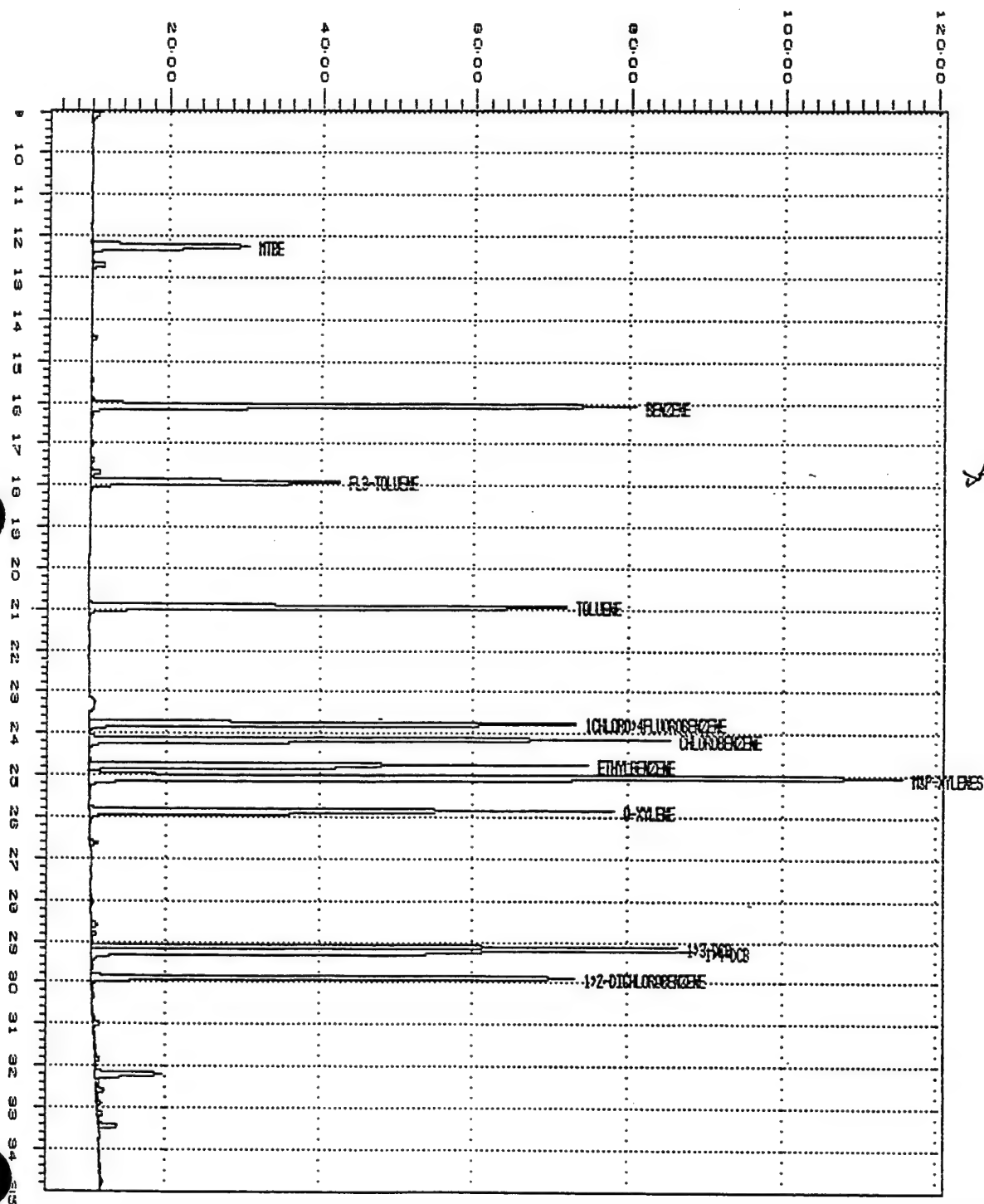
49298-09 PDIL=100% T=SA. Amount : 1.000.
 HP5890 INSTRUMENT 'H' PID RTx-502.2 105m. x 0.53ID. x 3.0um
 Acquired on 4-JUN-1996 at 14:32
 Reported on 4-JUN-1996 at 15:10
 Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VDA06_1] 16 H04JUN96,6,1

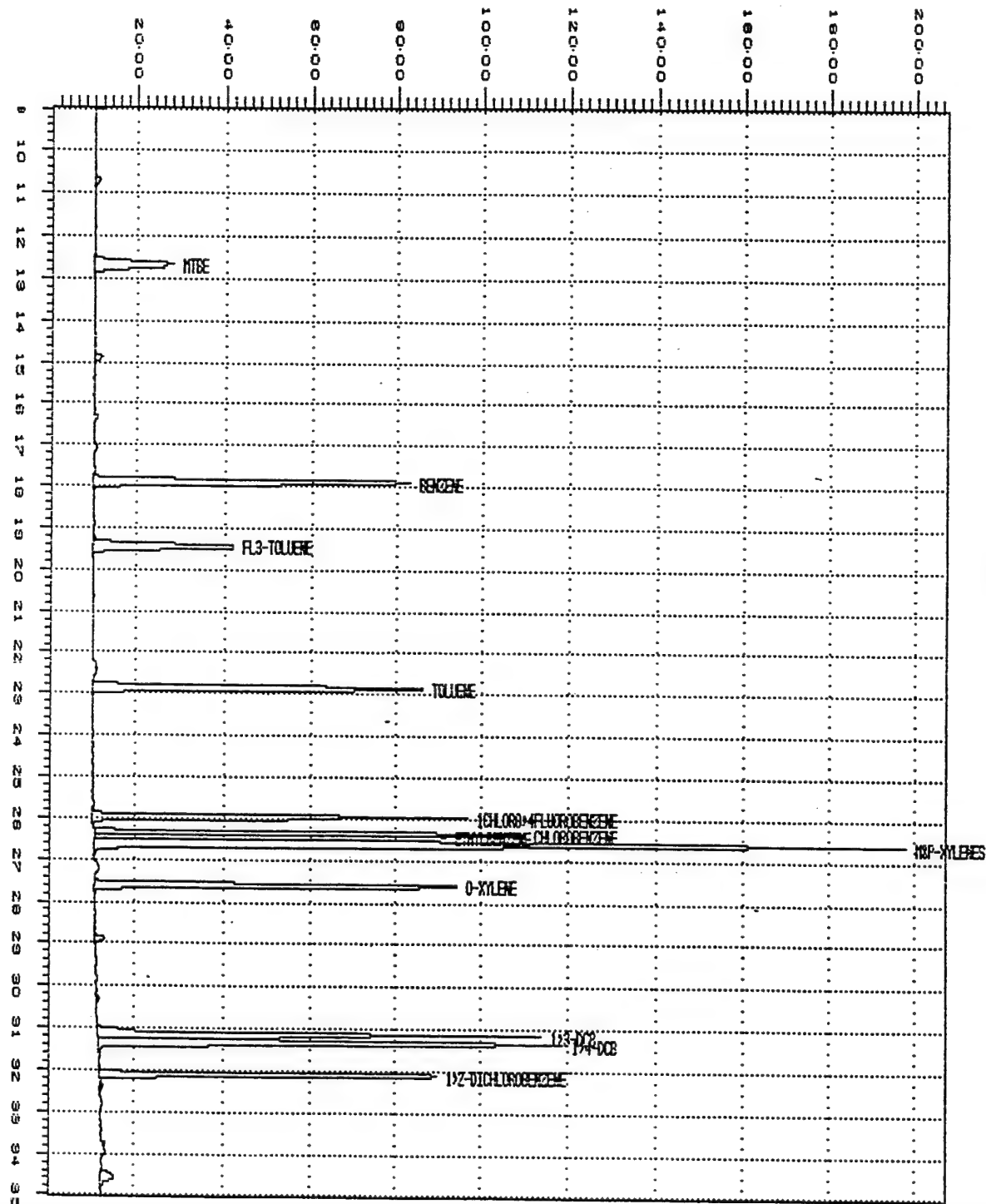
49298-09MS PDIL=100% T=SA. Amount : 1.000.
HP5890 INSTRUMENT 'H' PID RTx-1 60m. x 0.53ID. x 3.0um
Acquired on 4-JUN-1996 at 15:16
Reported on 4-JUN-1996 at 15:54
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VOA06_1] 15 H04JUN96,6,1

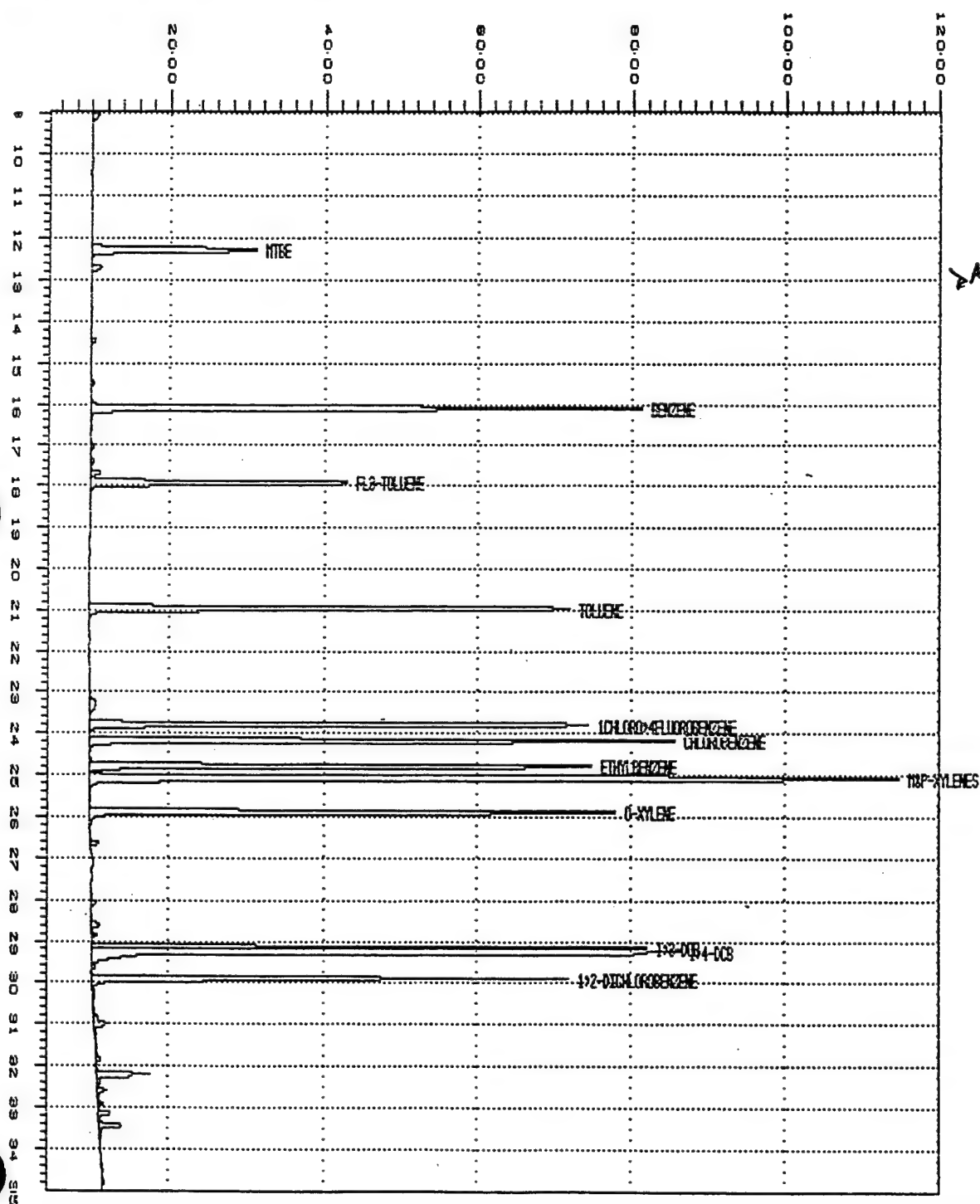
49298-09MS PDIL=100% T=SA. Amount : 1.000.
HP5890 INSTRUMENT 'H' PID RTx-502.2 105m. x 0.53ID. x 3.0um
Acquired on 4-JUN-1996 at 15:16
Reported on 4-JUN-1996 at 15:54
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[V0A06_1] 16 H04JUN96,7,1

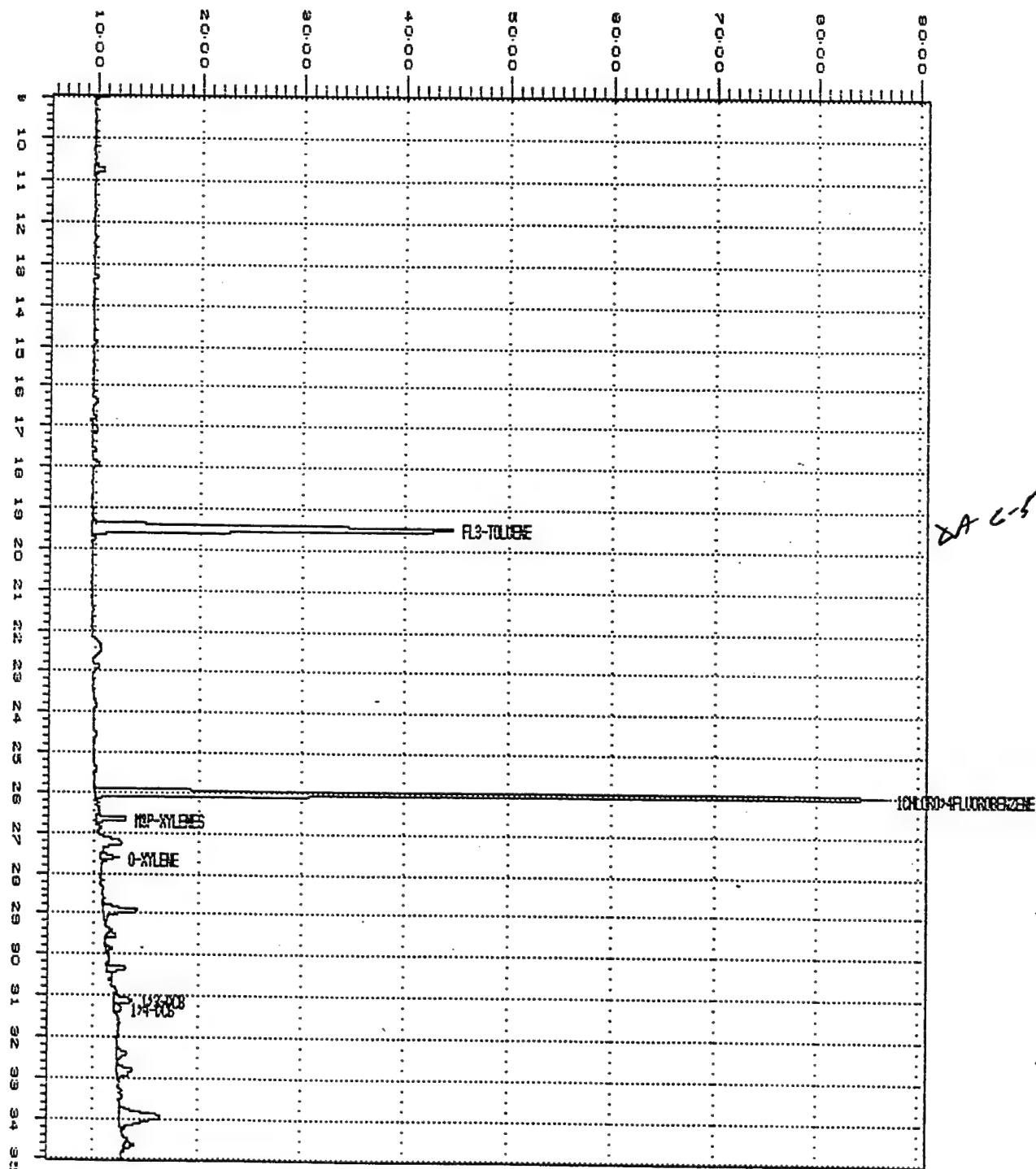
49298-09SD PDIL=100% T=SA. Amount : 1.000.
 HP5890 INSTRUMENT 'H' PID RTx-1 60m. x 0.53ID. x 3.0um
 Acquired on 4-JUN-1996 at 16:00
 Reported on 4-JUN-1996 at 16:38
 Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VOA06_1] 15 H04JUN96.18.1

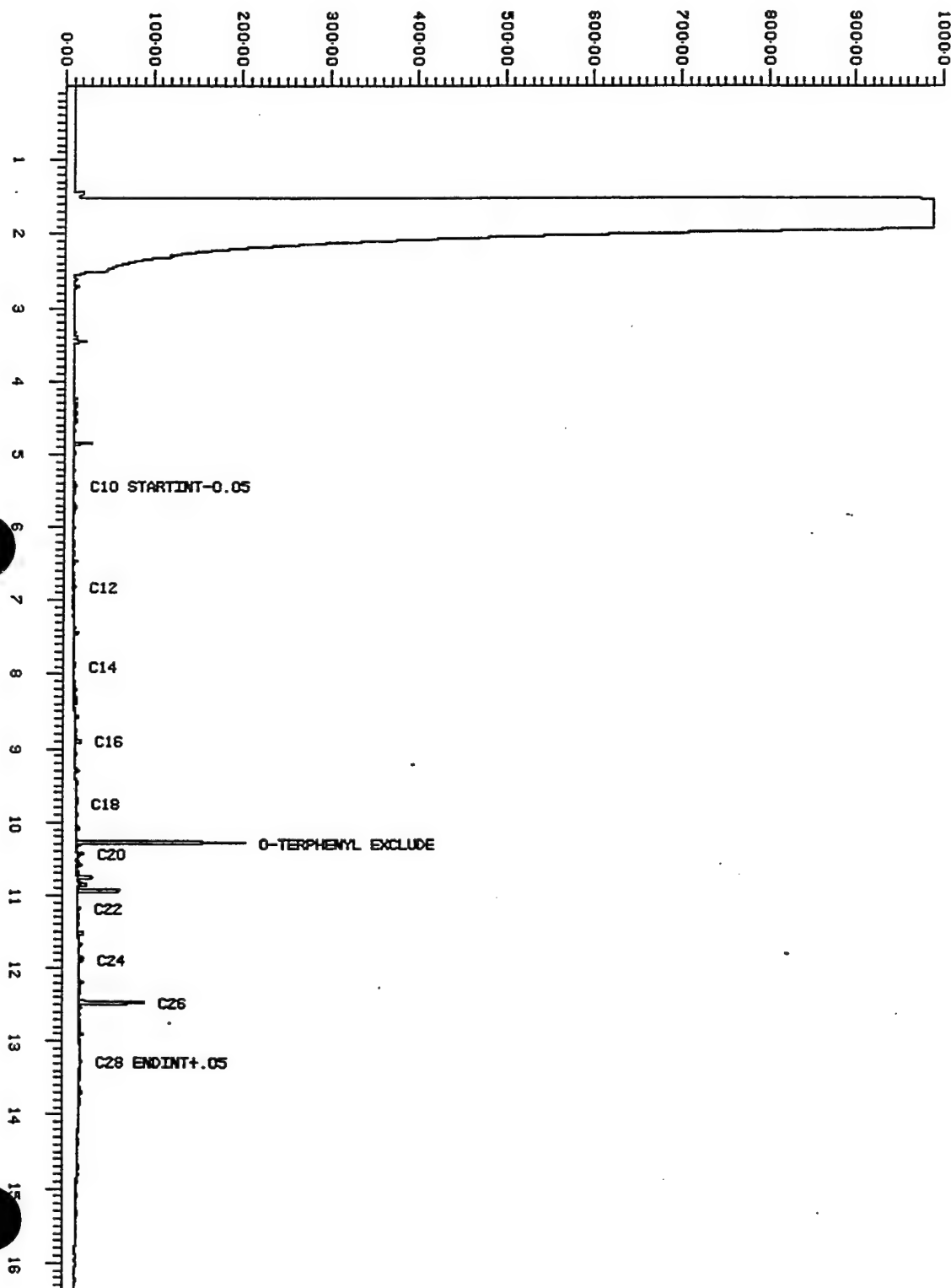
49298-10 PDIL=100% T=SA RU=MG/KG. Amount : 1.000.
HP5890 INSTRUMENT 'H' PID RTx-502.2 105m. x 0.53ID. x 3.0um
Acquired on 5-JUN-1996 at 00:39
Reported on 5-JUN-1996 at 01:16
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z13JUN96,9,1

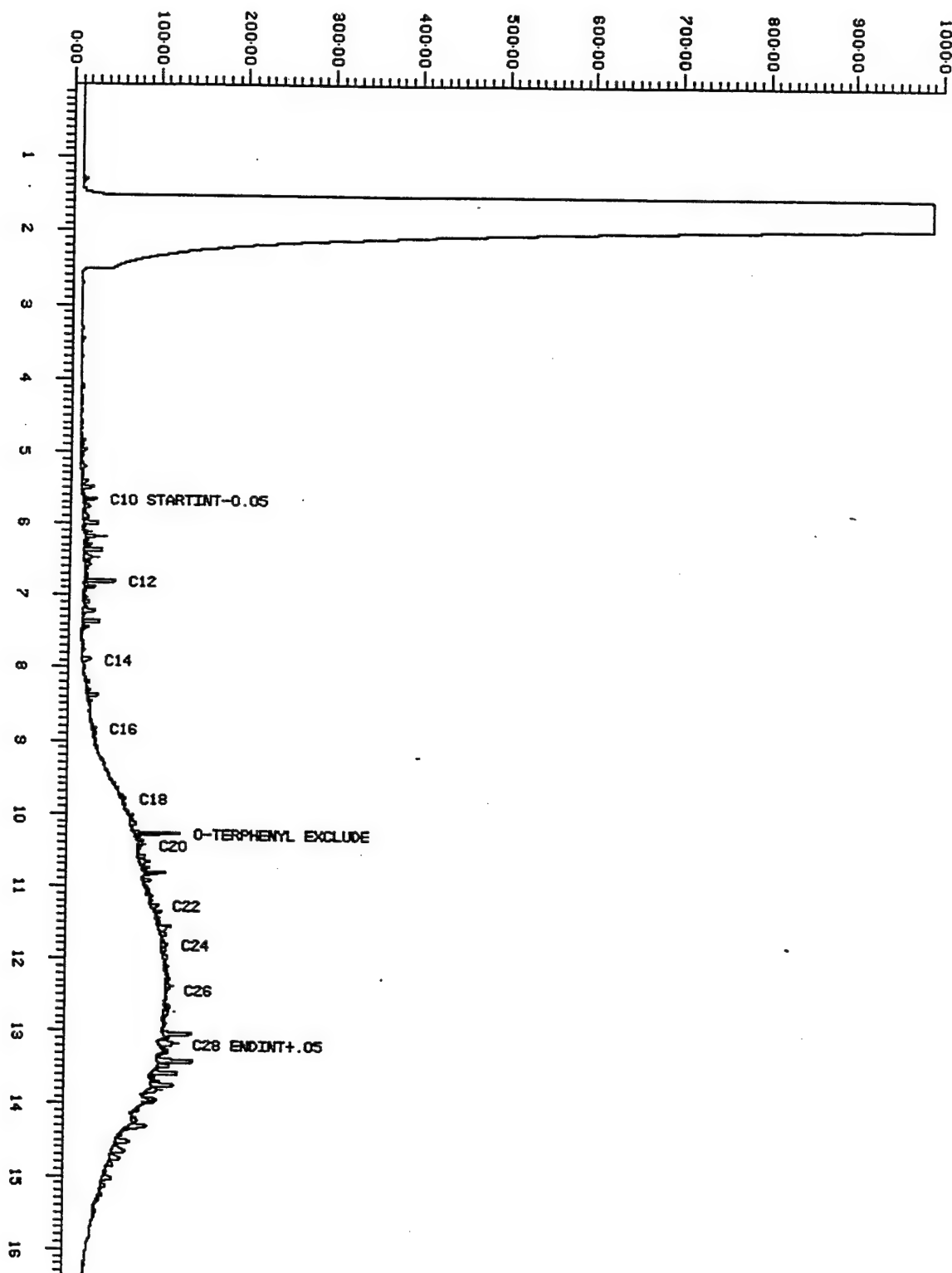
9298-02 T=SA. Amount : 1.000.
ESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length
Acquired on 13-JUN-1996 at 14:27
Reported on 13-JUN-1996 at 15:07
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z14JUN96,6,1

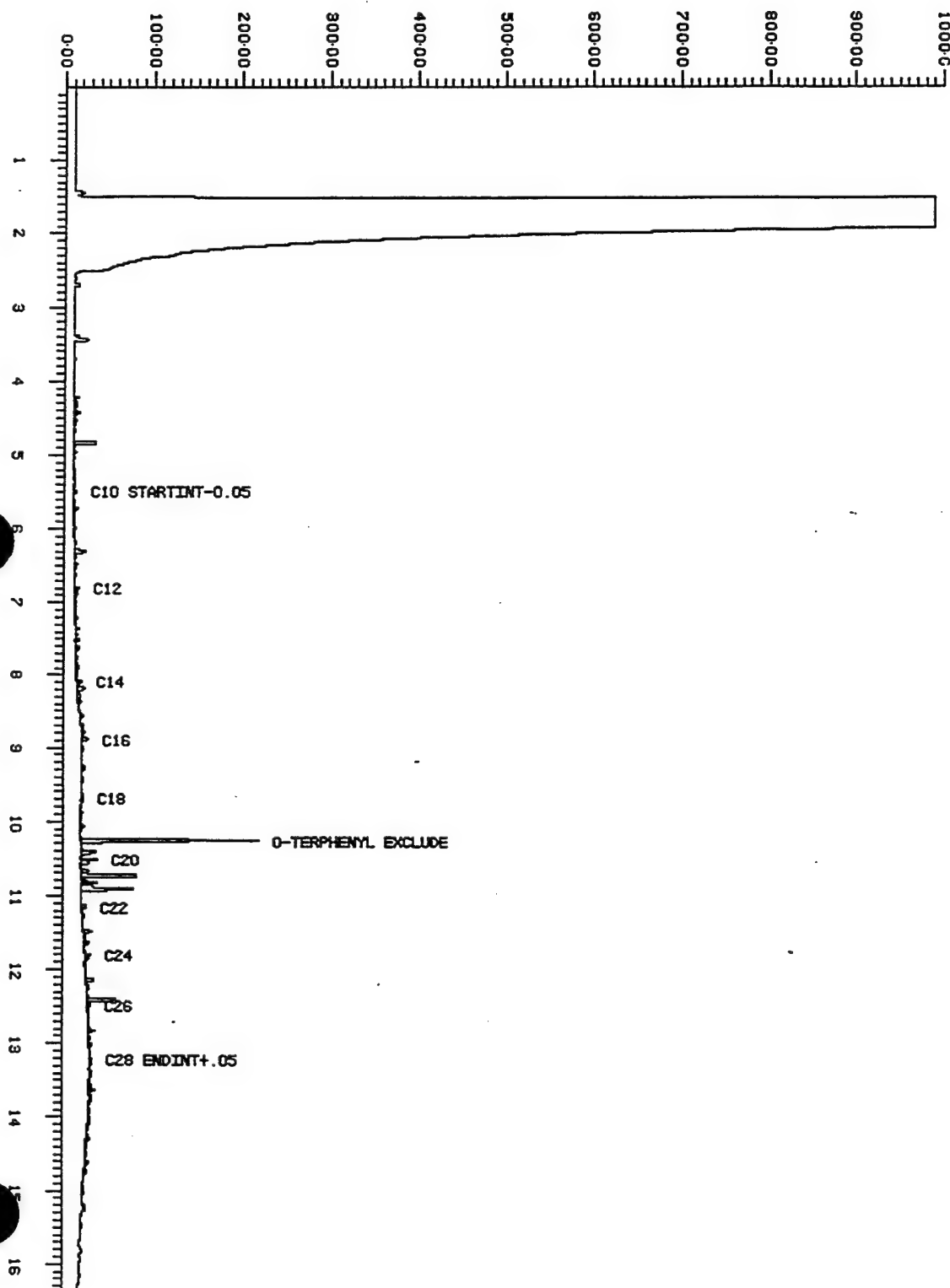
49298-03 PDIL=25% T=RD. Amount : 1.000.
RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length
Acquired on 14-JUN-1996 at 11:51
Reported on 14-JUN-1996 at 12:23
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z14JUN96,7,1

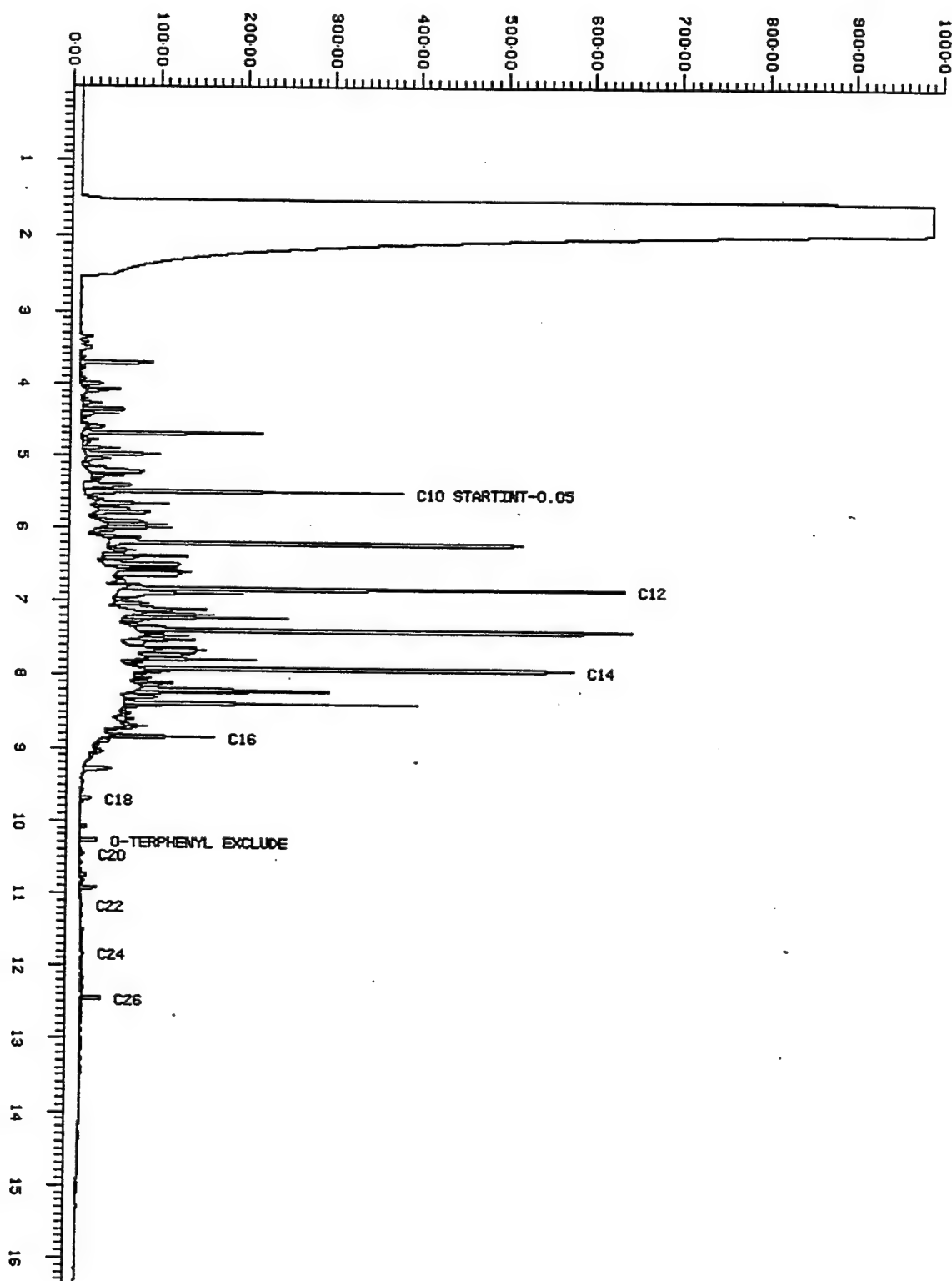
9298-04 PDIL=100% T=RD. Amount : 1.000.
RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length
Acquired on 14-JUN-1996 at 12:25
Reported on 14-JUN-1996 at 12:57
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z14JUN96,8,1

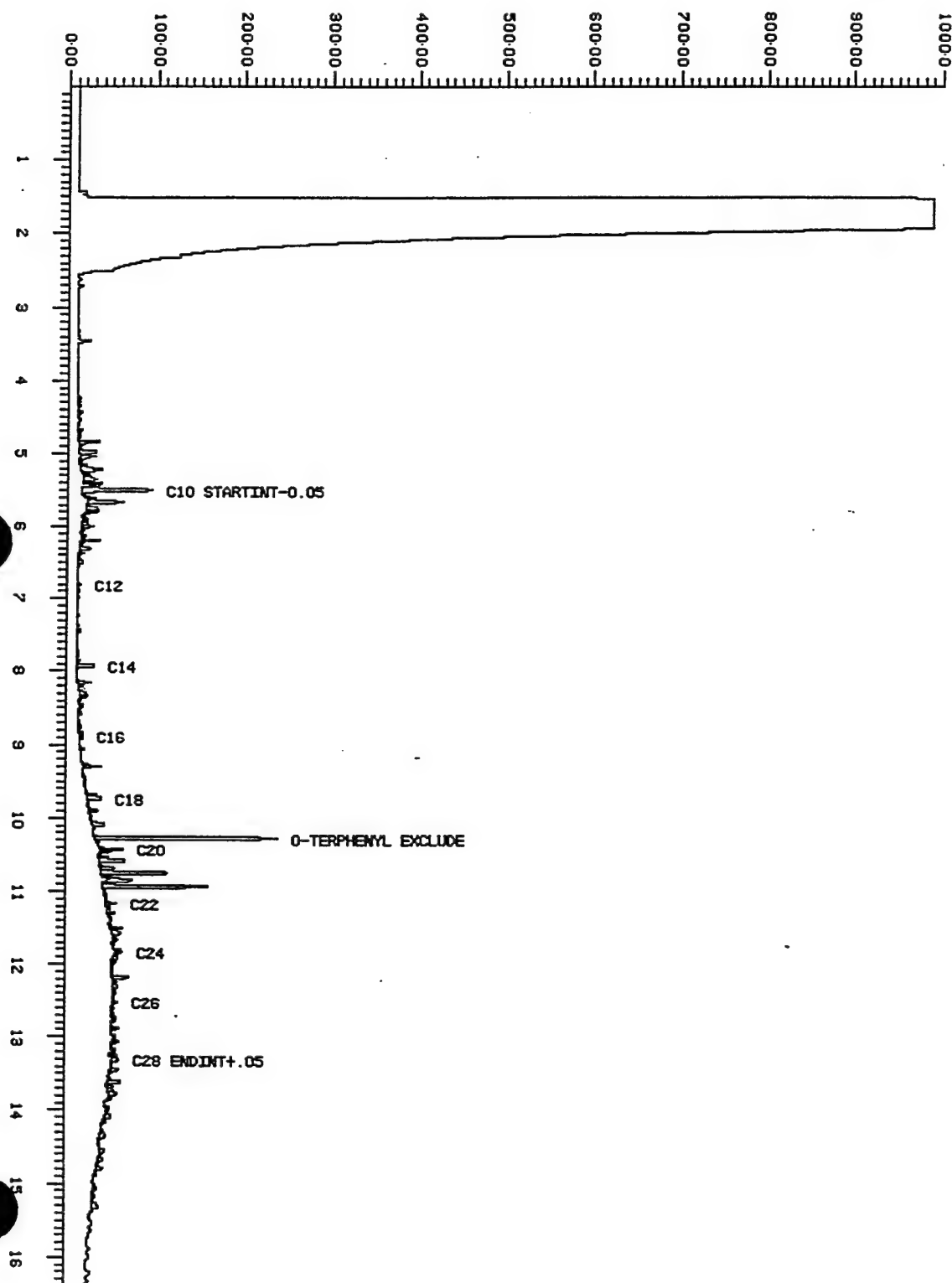
49298-05 PDIL=10% T=RD. Amount : 1.000.
RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length
Acquired on 14-JUN-1996 at 12:59
Reported on 14-JUN-1996 at 13:31
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z14JUN96,9,1

9298-06 PDIL=100% T=RD. Amount : 1.000.
RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length
Acquired on 14-JUN-1996 at 13:33
Reported on 14-JUN-1996 at 14:05
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z13JUN96,14,1

49298-07

T=SA.

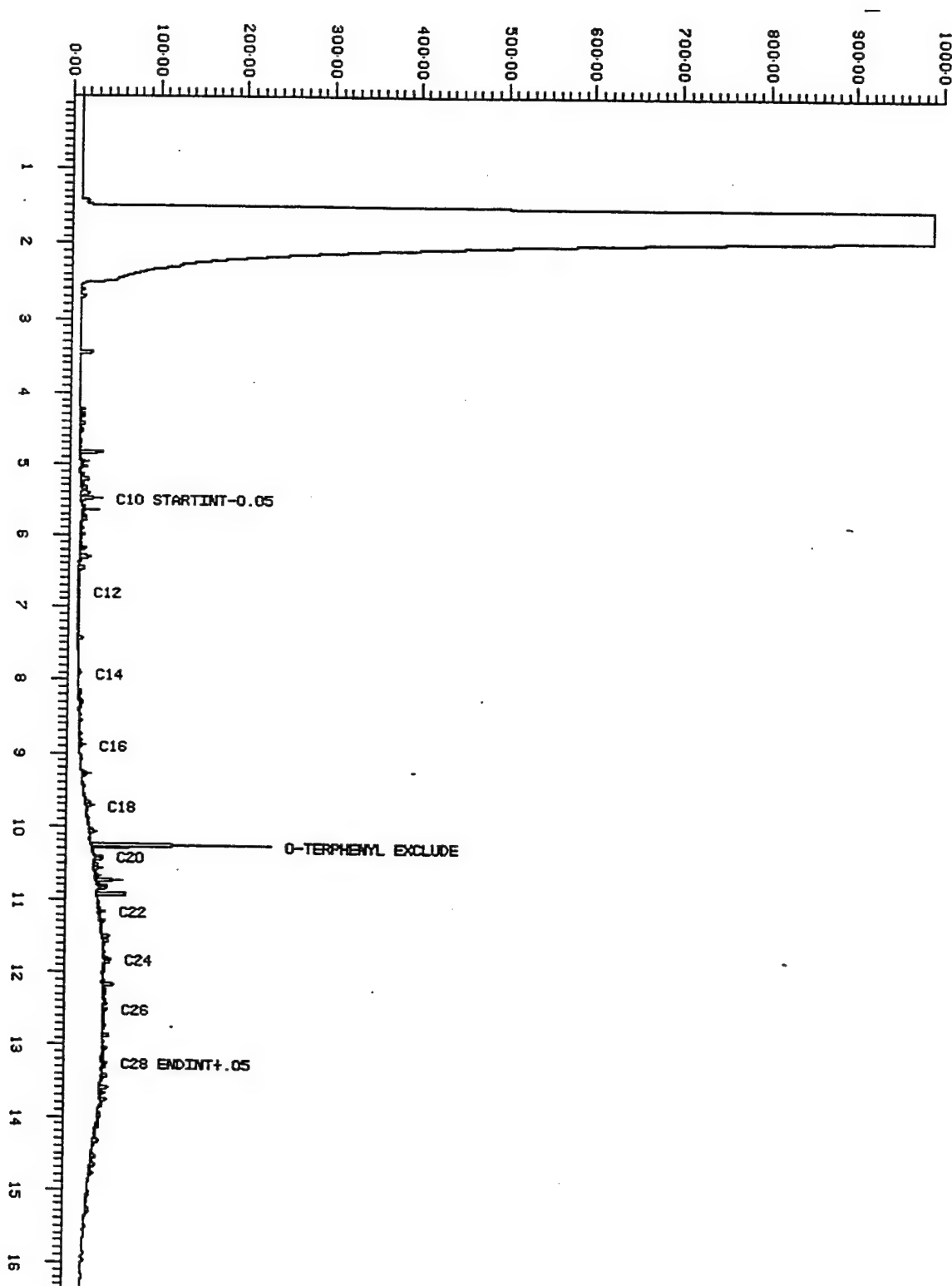
Amount : 1.000.

RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length

Acquired on 13-JUN-1996 at 17:22

Reported on 13-JUN-1996 at 17:54

Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z13JUN96,15,1

49298-08

T=SA.

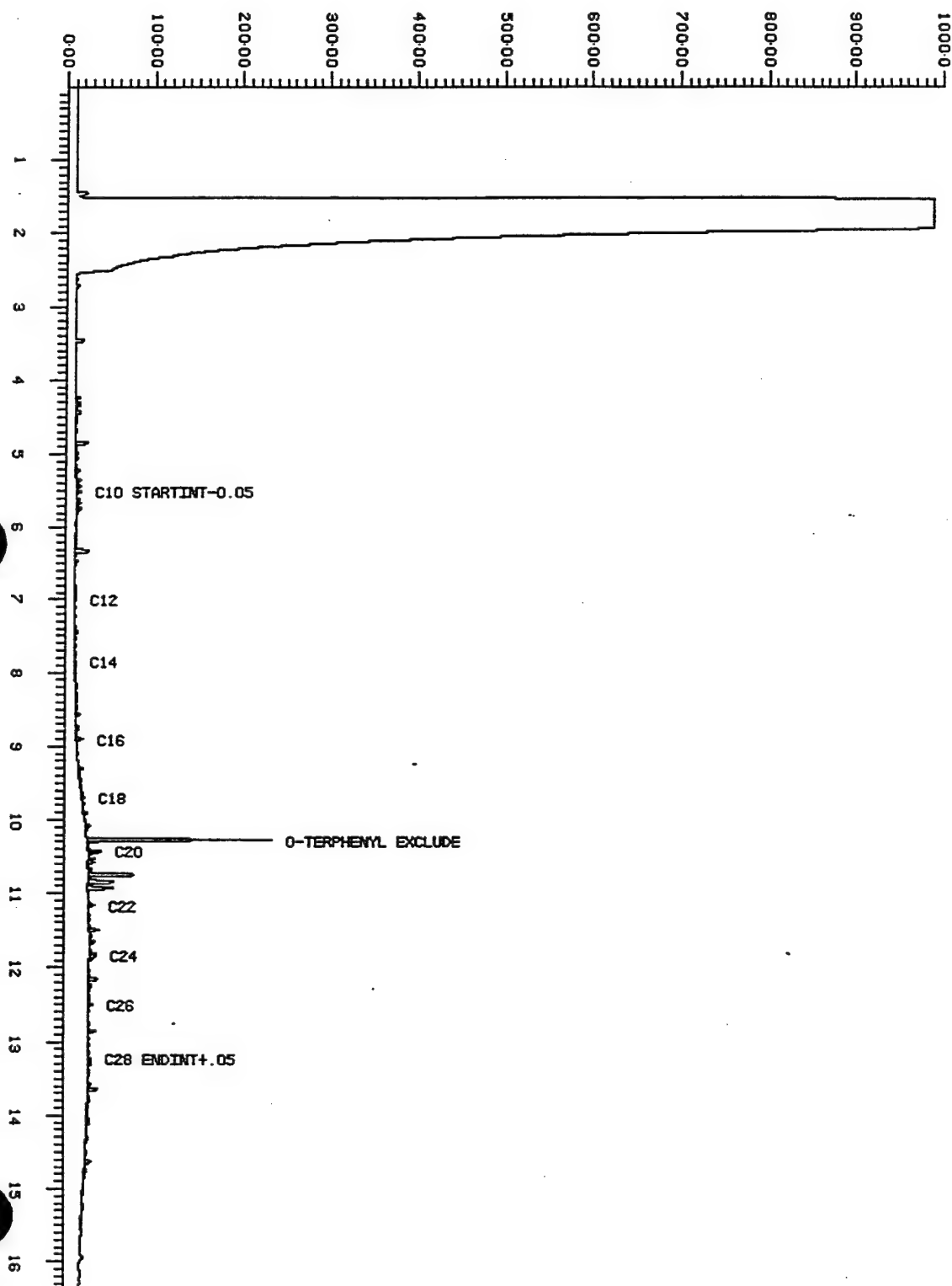
Amount : 1.000.

RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length

Acquired on 13-JUN-1996 at 17:56

Reported on 13-JUN-1996 at 18:28

Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z13JUN96,19,1

49298-09

T=SA.

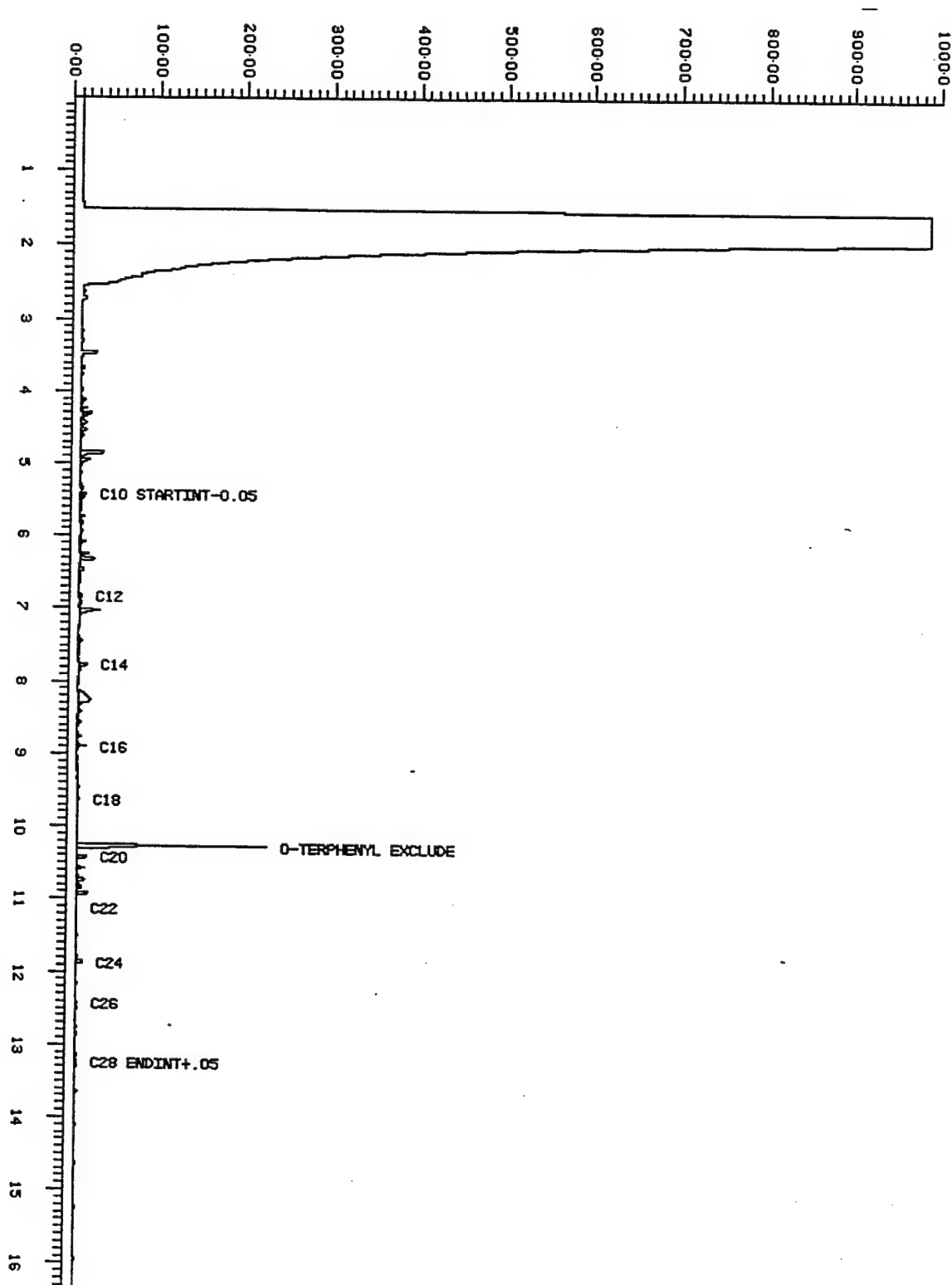
Amount : 1.000.

RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length

Acquired on 13-JUN-1996 at 20:11

Reported on 13-JUN-1996 at 20:43

Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z13JUN96,20,1

49298-09MS

T=SA.

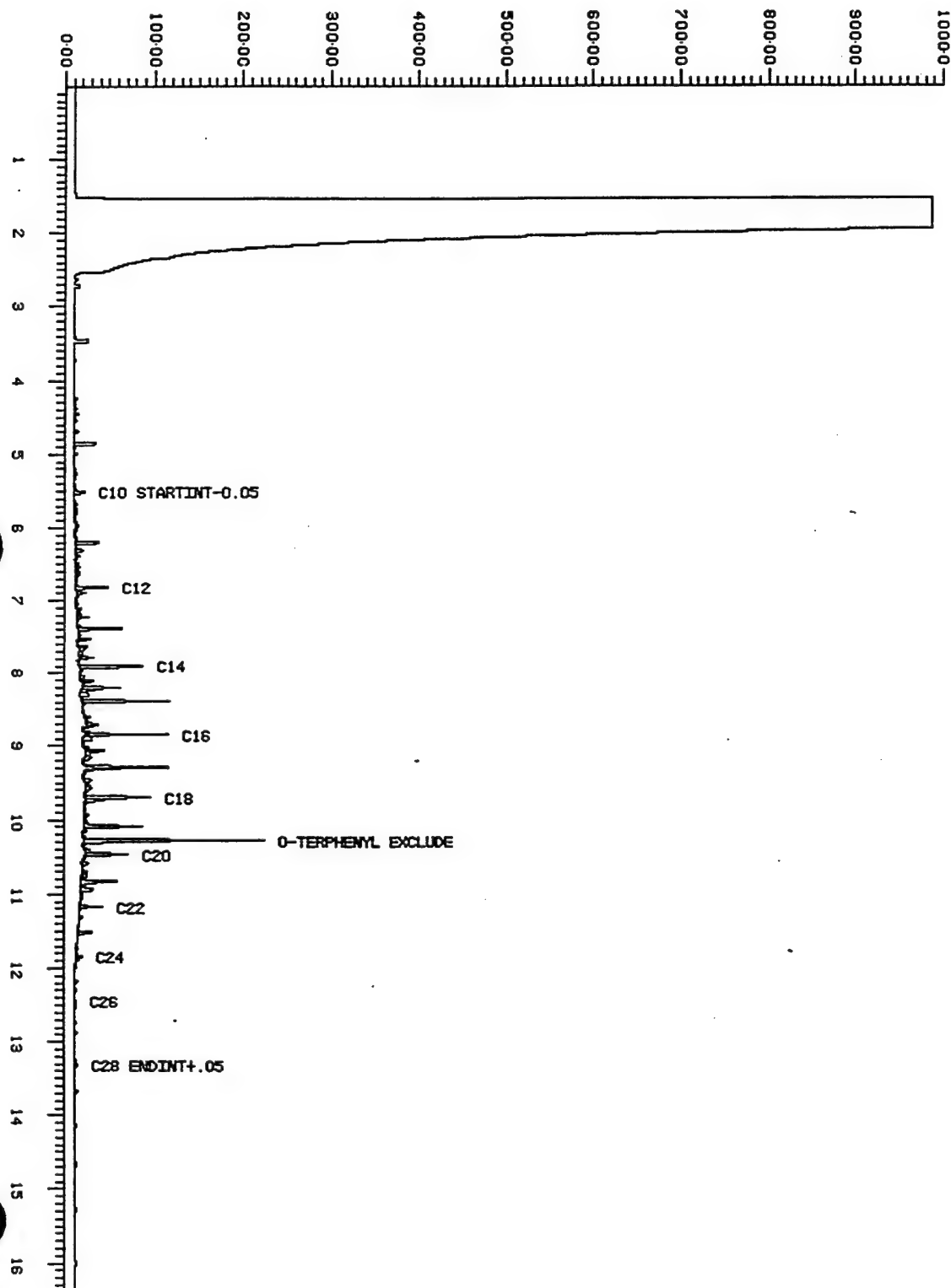
Amount : 1.000.

RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length

Acquired on 13-JUN-1996 at 20:45

Reported on 13-JUN-1996 at 21:17

Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z13JUN96,21,1

49298-09SD

T=SA.

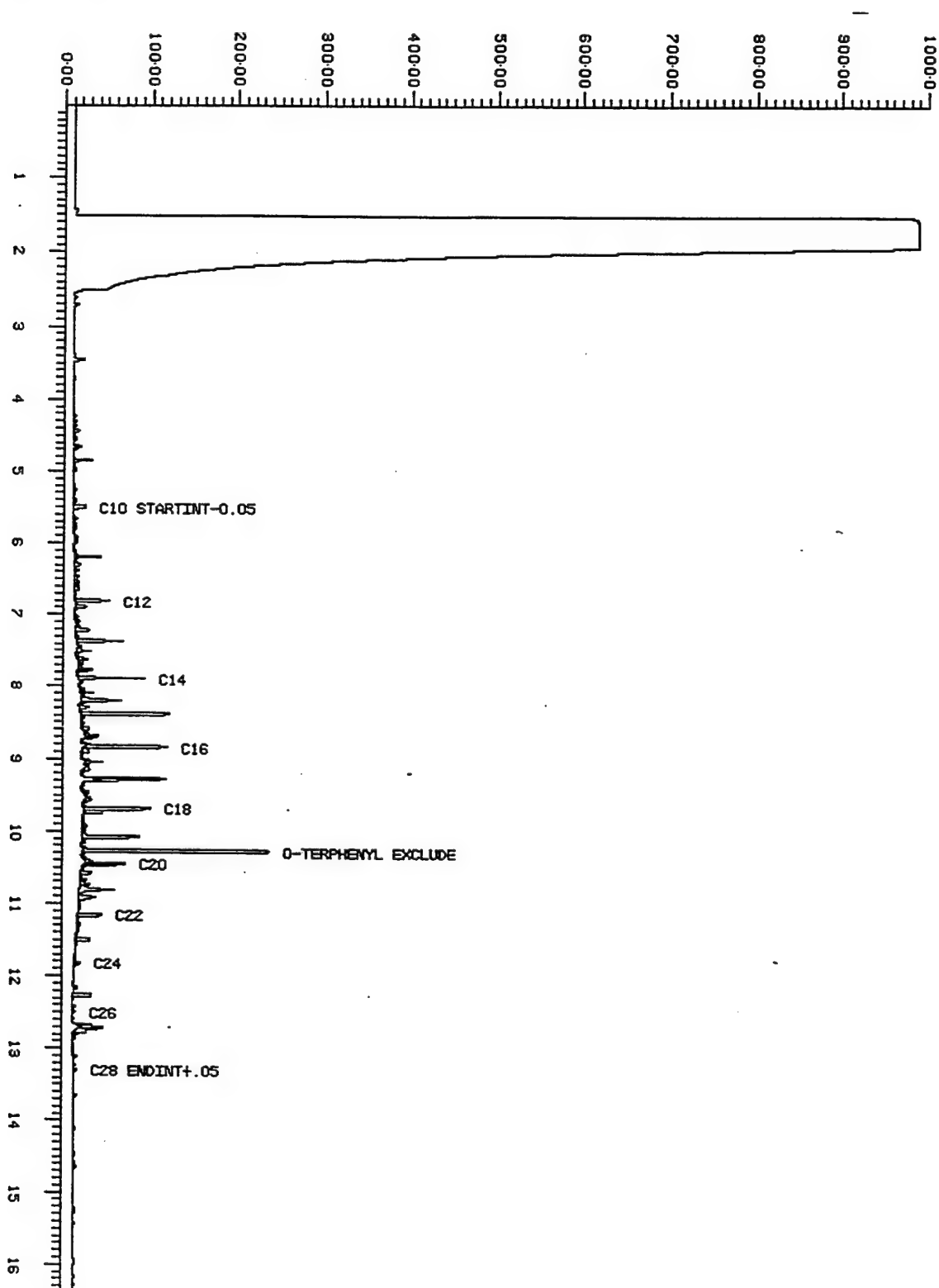
Amount : 1.000.

RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length

Acquired on 13-JUN-1996 at 21:19

Reported on 13-JUN-1996 at 21:50

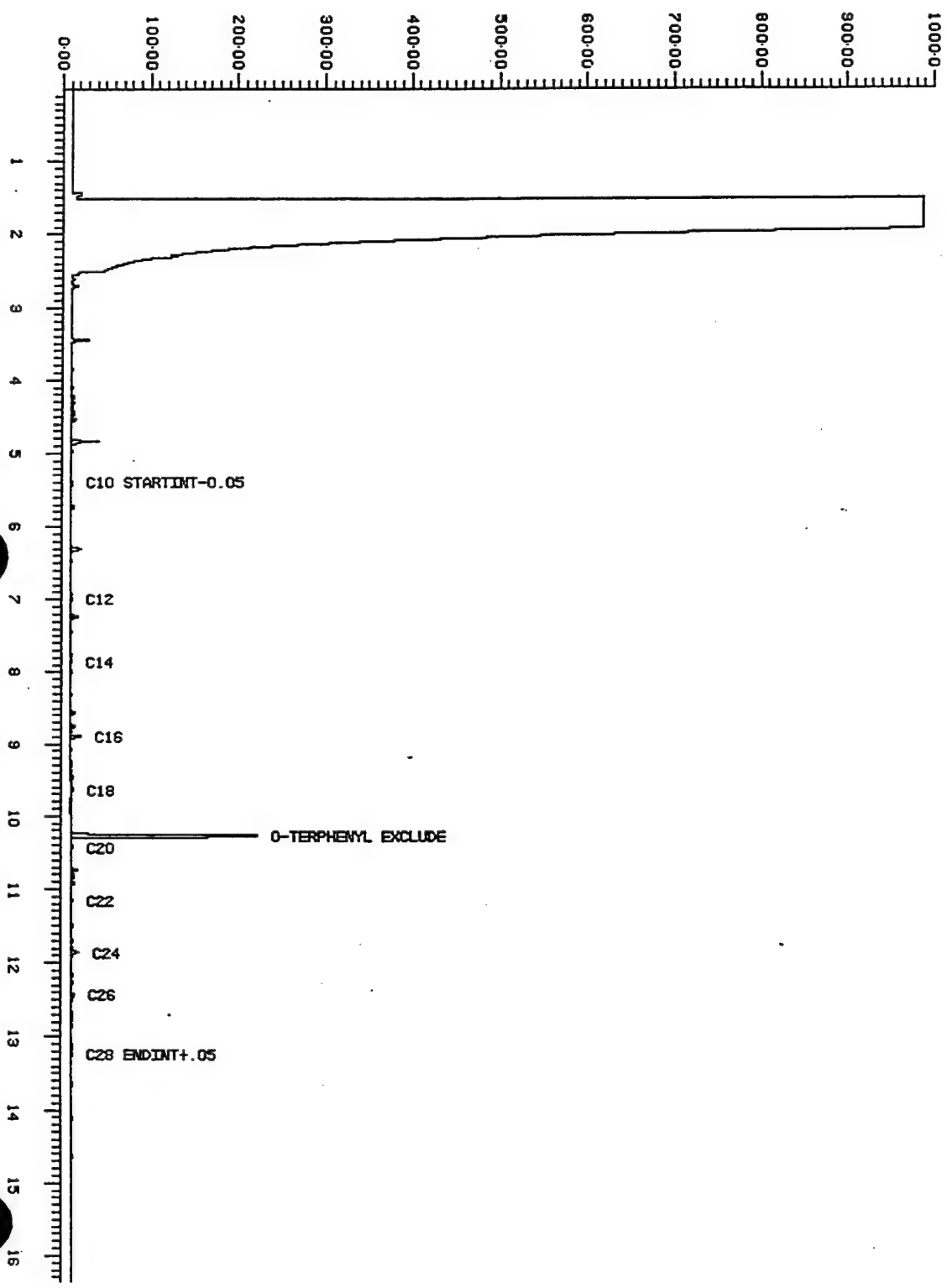
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_2] 75 Z13JUN96,22,1

19298-10 T=SA. Amount : 1.000.
ESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length
Acquired on 13-JUN-1996 at 21:53
Reported on 13-JUN-1996 at 22:24
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[FID06_1] 46 05JUNFO2,15,1

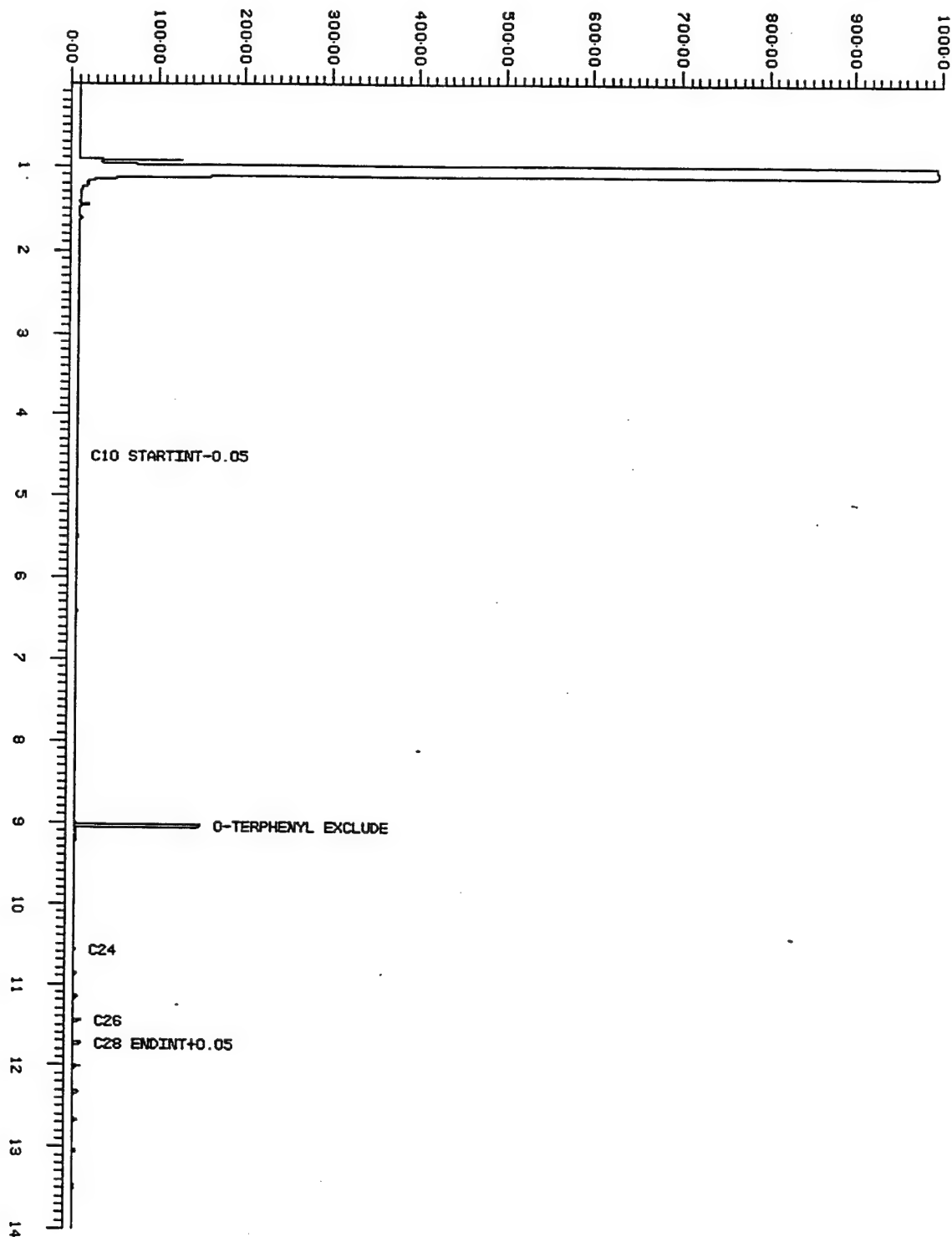
49298-12 AMT=0.990L PDIL=100% T=SA. Amount : 1.000.

RESTEK RTx-5, 0.25mm ID, 0.25um film, 30m length

Acquired on 5-JUN-1996 at 18:16

Reported on 5-JUN-1996 at 18:48

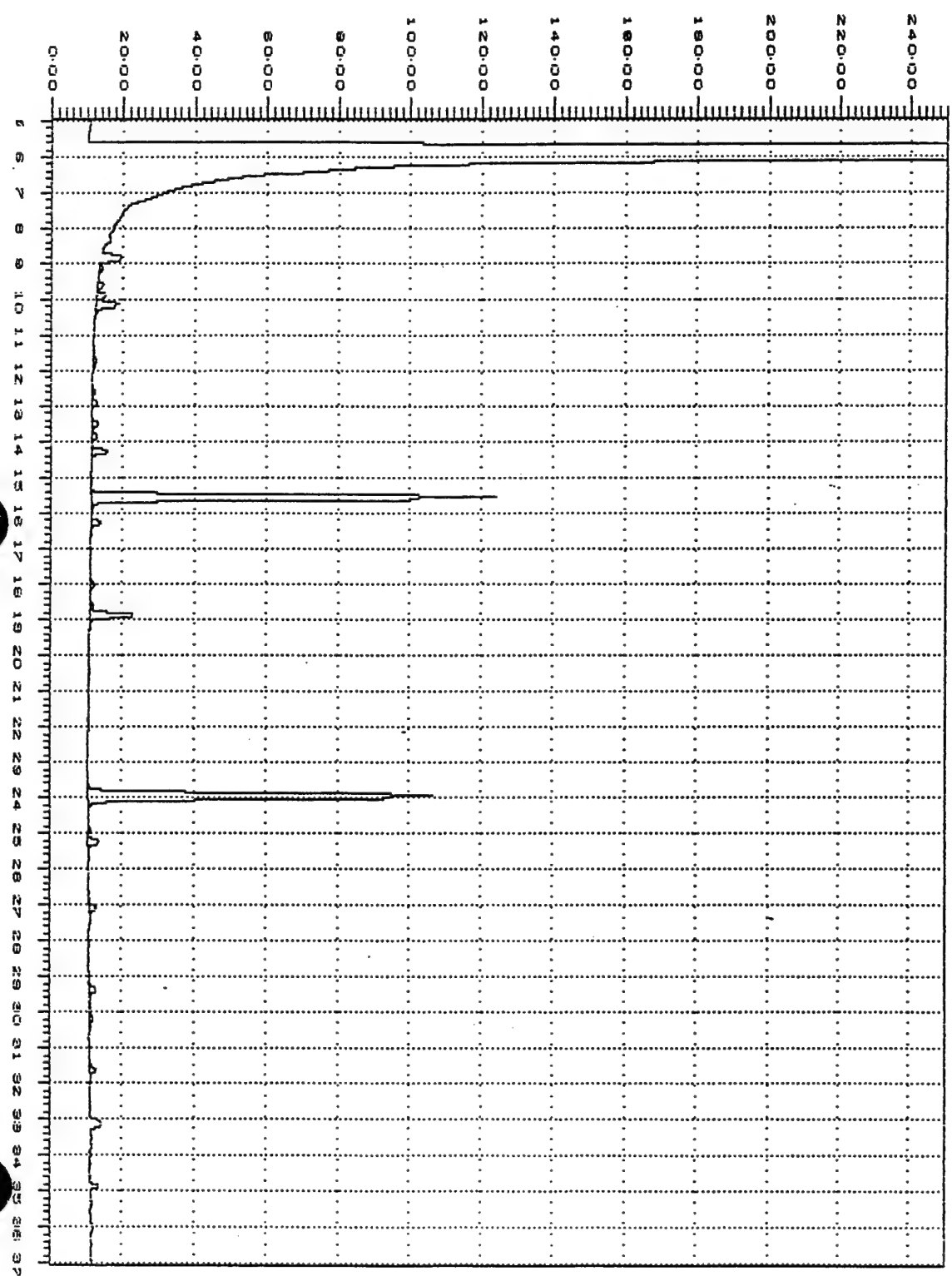
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VDA06_1] 50 L05JUN96,6,1

49298-02 PDIL=100% T=SA. Amount : 1.000.
 HP 5890 INSTRUMENT 'L' FID DETECTOR
 Acquired on 5-JUN-1996 at 14:44
 Reported on 5-JUN-1996 at 15:22
 Box 1 (of 1)



8A6-4

Quanterra Denver Multichrom V2.1

[VDA06_1] 50 L05JUN96,7,1

49298-03 PDIL=100%

T=SA.

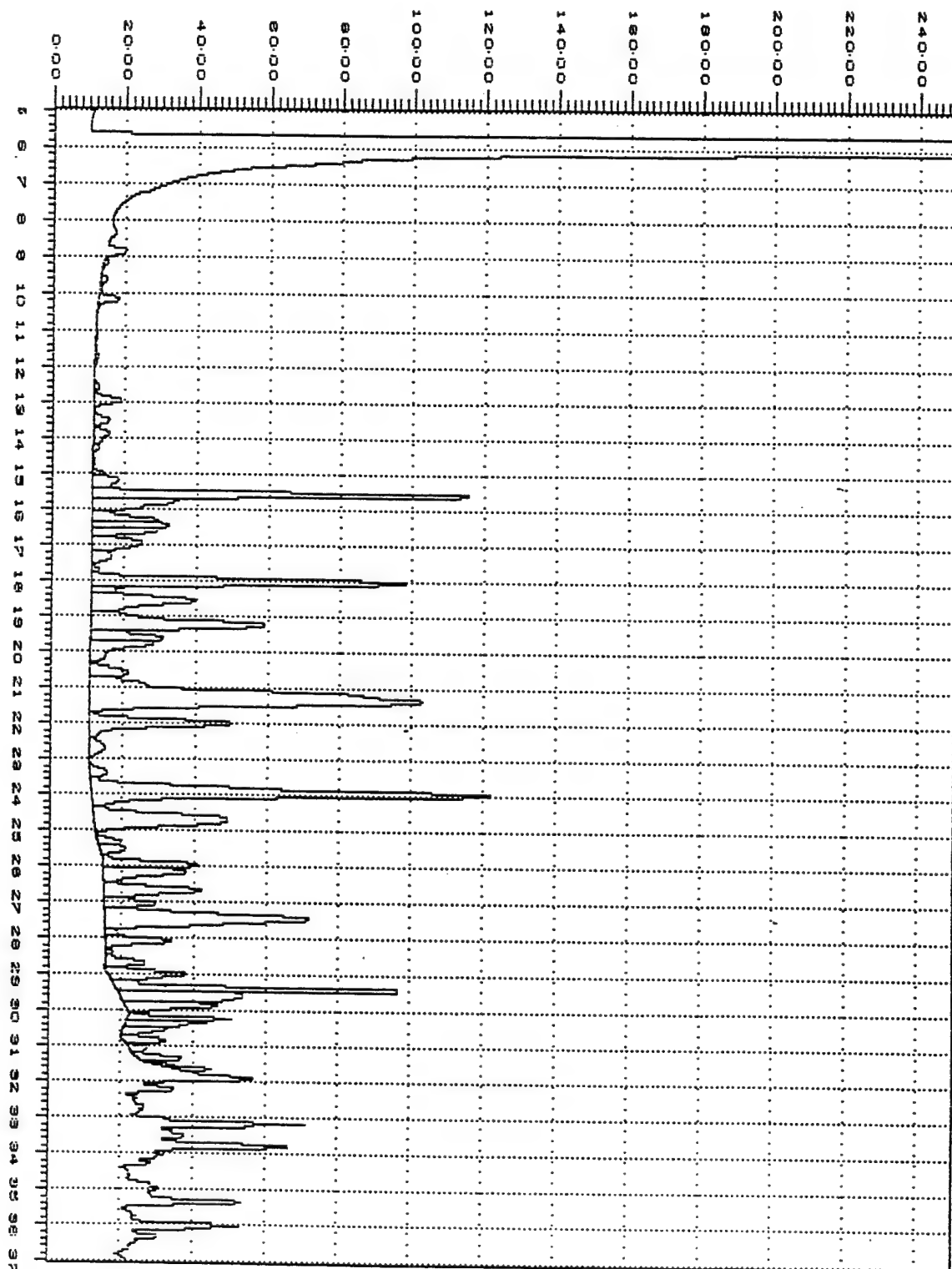
Amount : 1.000.

HP 5890 INSTRUMENT 'L' FID DETECTOR

Acquired on 5-JUN-1996 at 15:33

Reported on 5-JUN-1996 at 16:10

Box 1 (of 1)

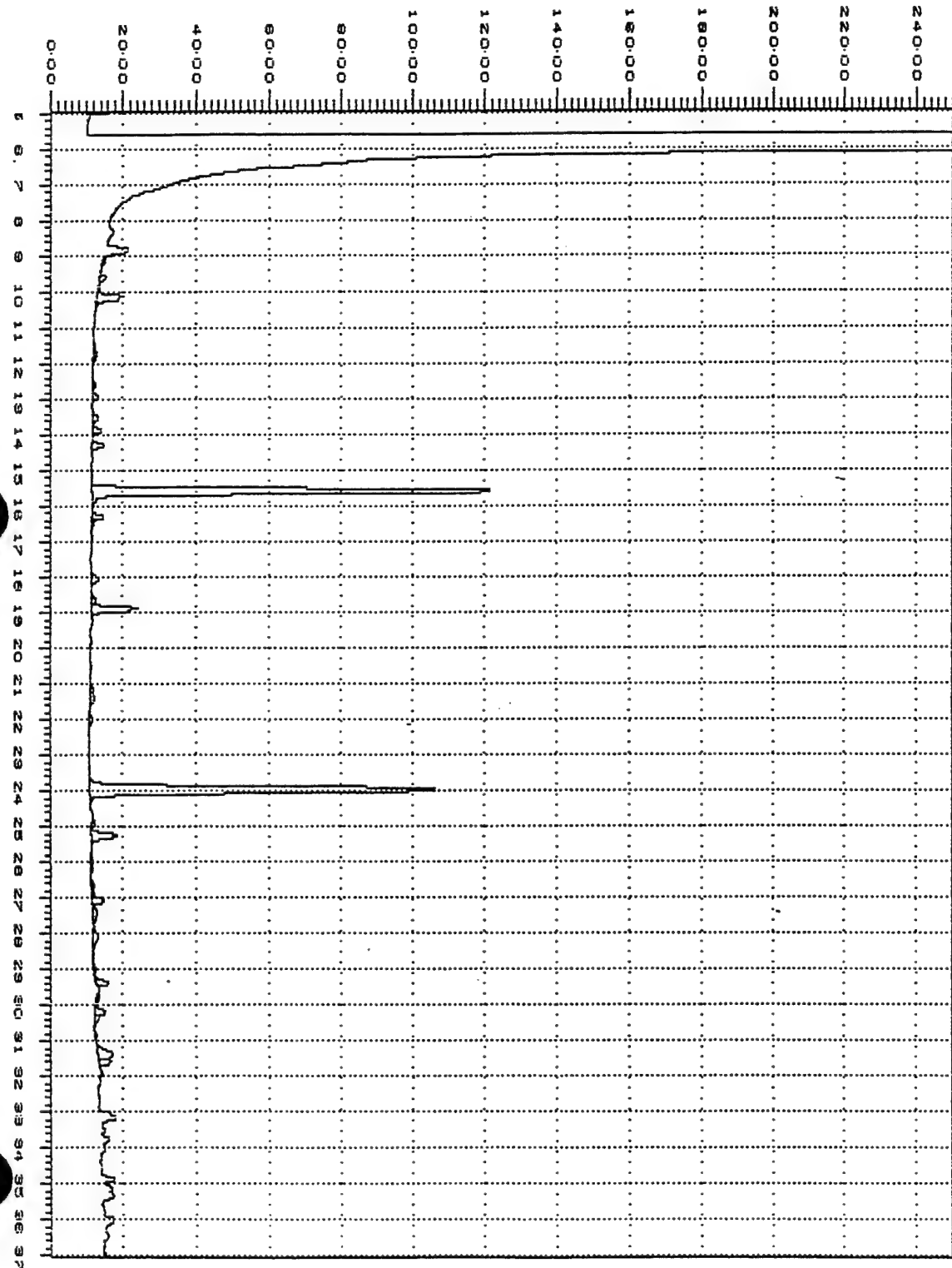


24.6

Quanterra Denver Multichrom V2.1

[VOA06_1] 50 L05JUN96,8,1

49298-04 PDIL=100% T=SA. Amount : 1.000.
 HP 5890 INSTRUMENT 'L' FID DETECTOR
 Acquired on 5-JUN-1996 at 16:22
 Reported on 5-JUN-1996 at 16:59
 Box 1 (of 1)



246

Quanterra Denver Multichrom V2.1

[VOA06_1] 50 L05JUN96,21,1

49298-05 PDIL=1%

T=RD.

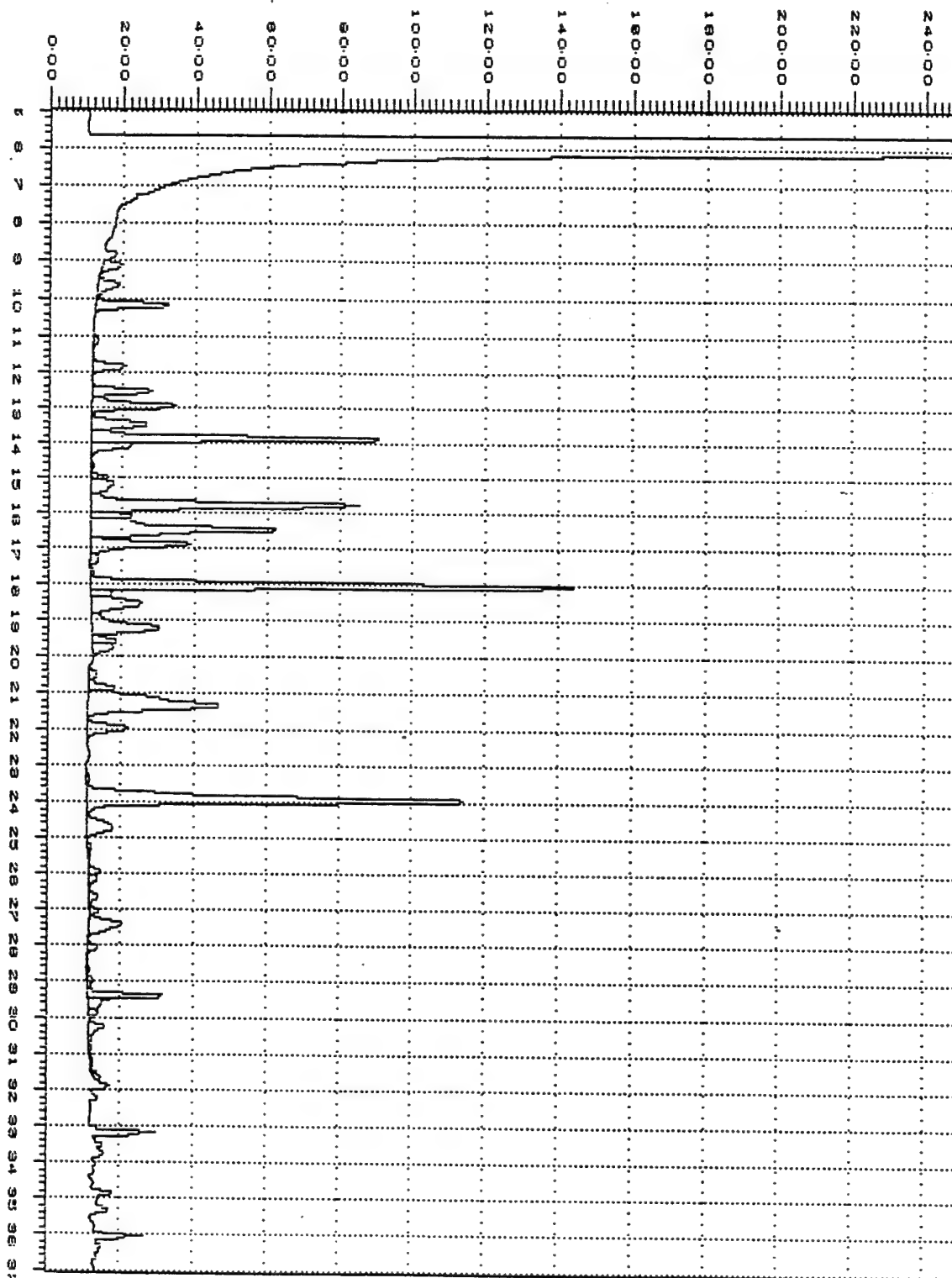
Amount : 1.000.

HP 5890 INSTRUMENT 'L' FID DETECTOR

Acquired on 6-JUN-1996 at 02:45

Reported on 6-JUN-1996 at 03:23

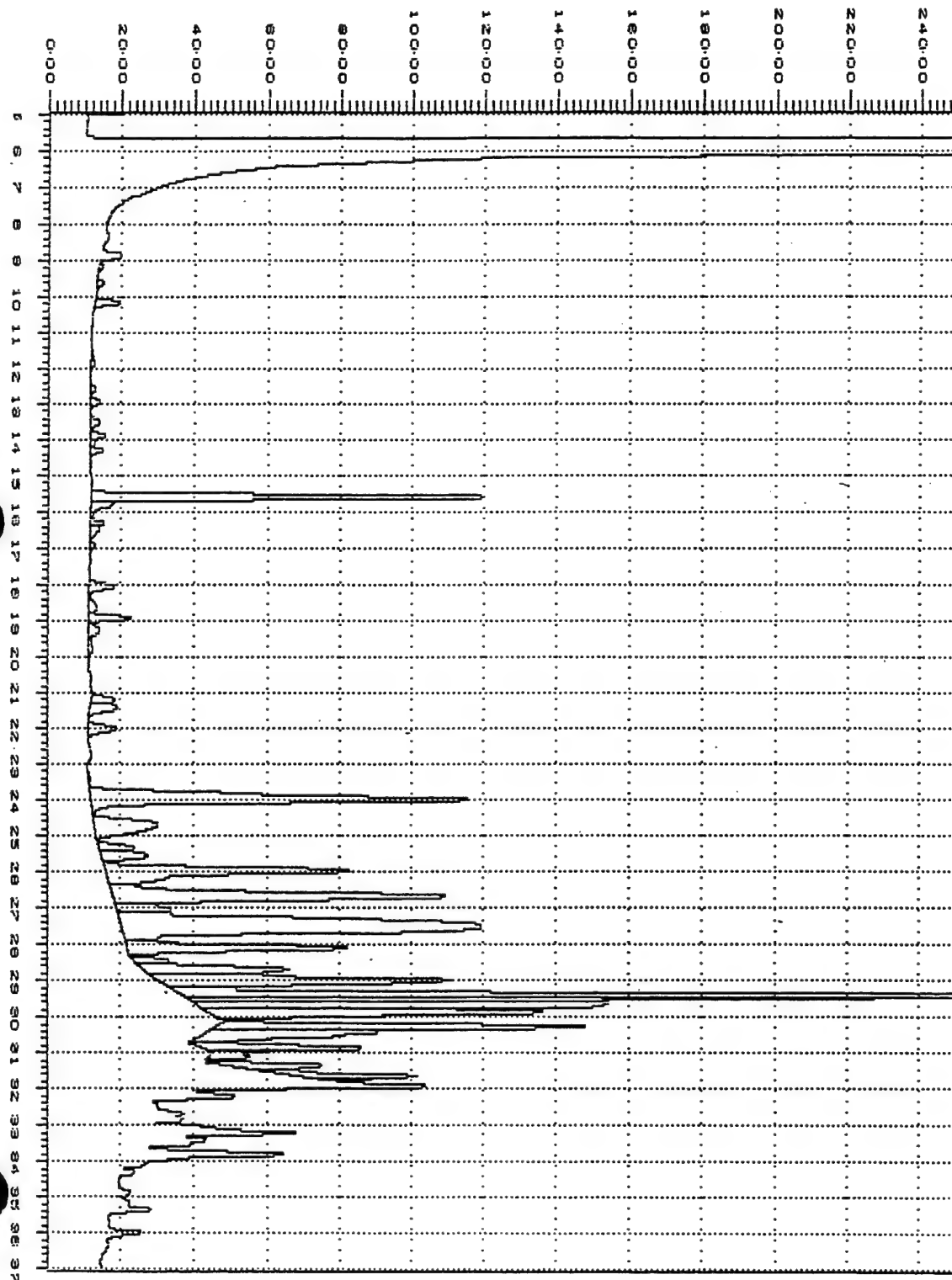
Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VDA06_1] 50 L05JUN96,10,1

49298-06 PDIL=100% T=SA. Amount : 1.000.
 HP 5890 INSTRUMENT 'L' FID DETECTOR
 Acquired on 5-JUN-1996 at 18:00
 Reported on 5-JUN-1996 at 18:37
 Box 1 (of 1)



2A 6-2

Quanterra Denver Multichrom V2.1

[VOA06_1] 50 L05JUN96,11,1

49298-07 PDIL=100%

T=SA.

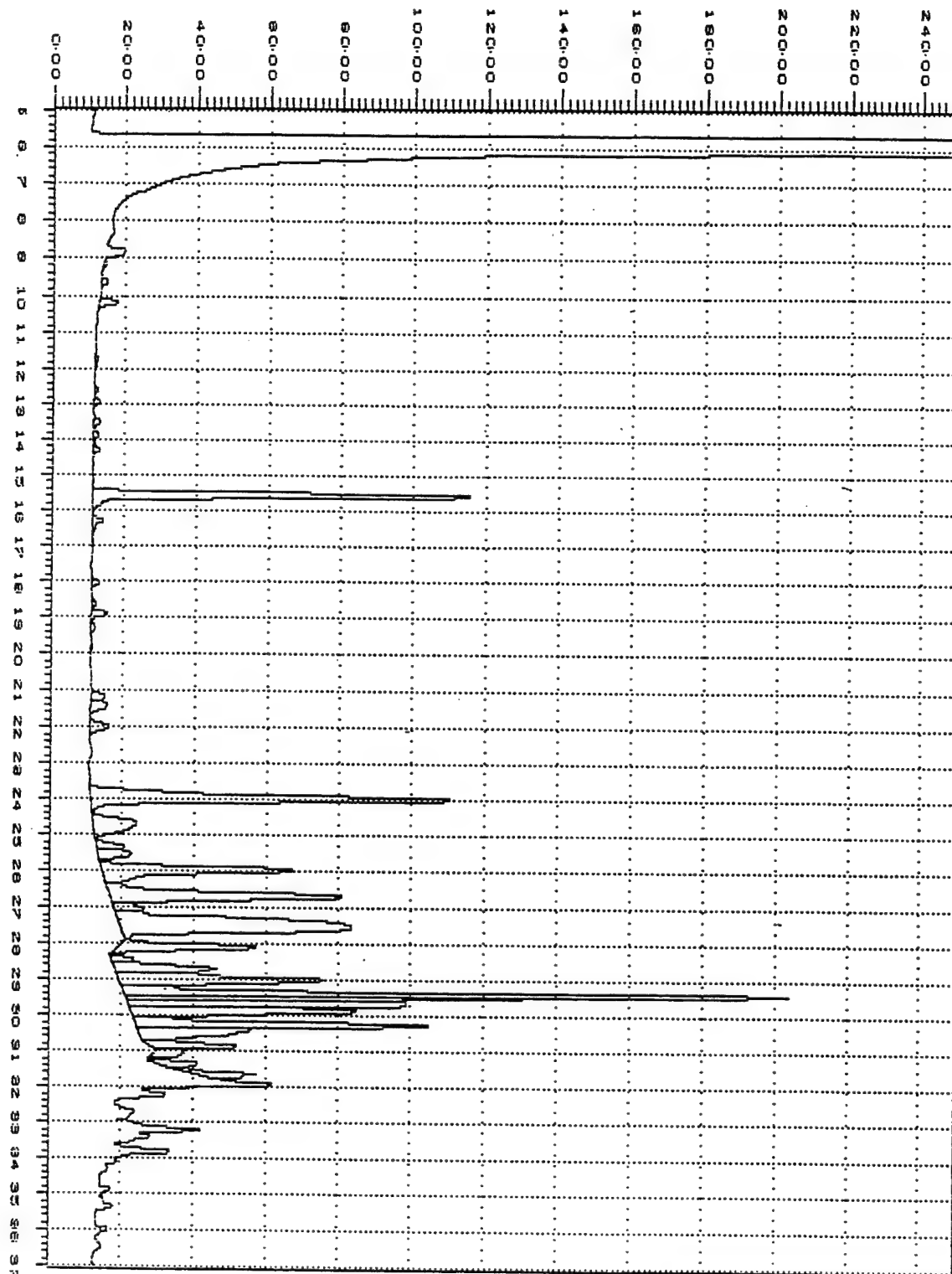
Amount : 1.000.

HP 5890 INSTRUMENT 'L' FID DETECTOR

Acquired on 5-JUN-1996 at 18:48

Reported on 5-JUN-1996 at 19:26

Box 1 (of 1)

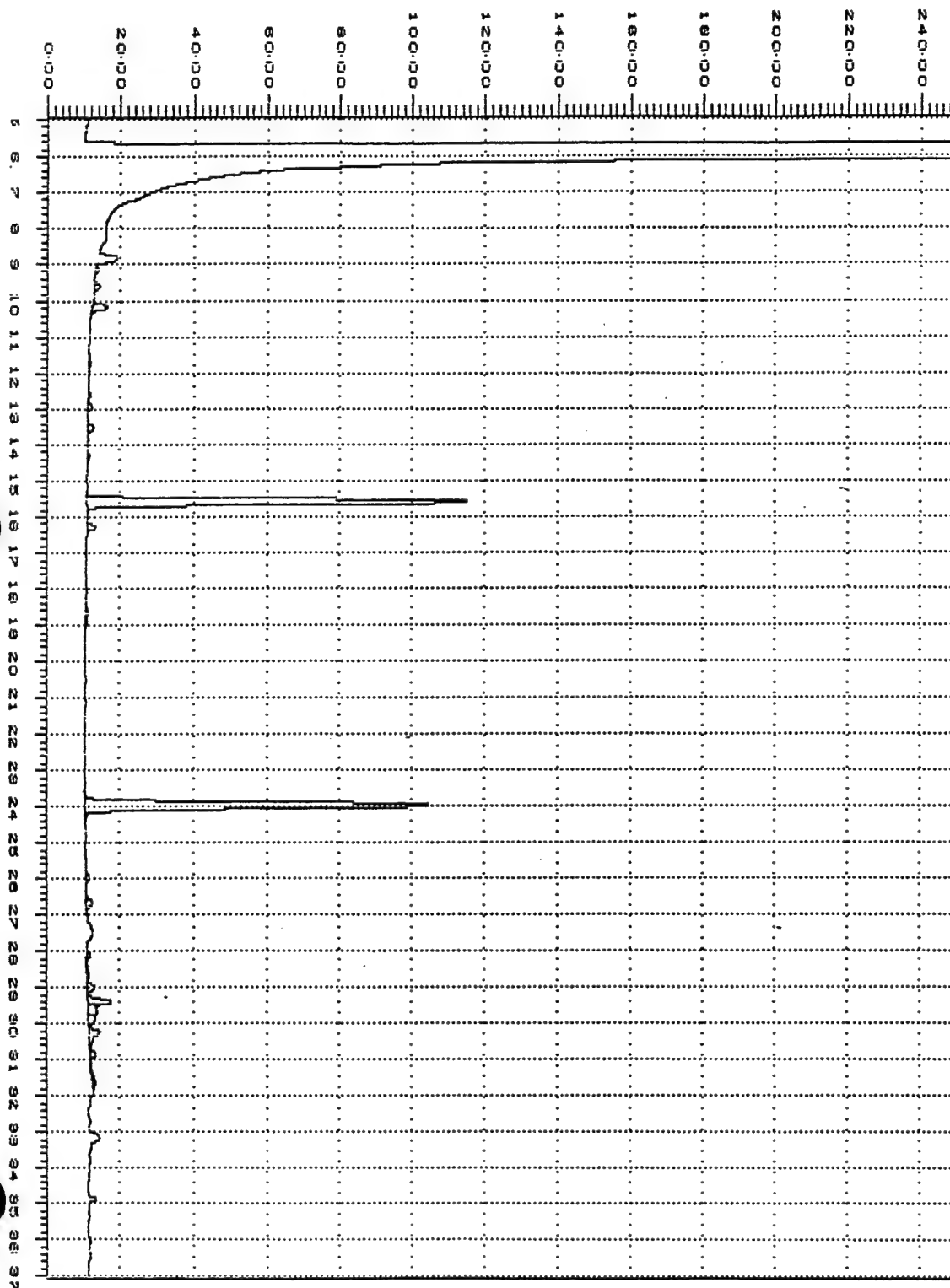


2K L-4

Quanterra Denver Multichrom V2.1

[VDA86_1] 58 L05JUN96,12,1

49298-88 PDIL=100% T=SA. Amount : 1.000.
HP 5890 INSTRUMENT 'L' FID DETECTOR
Acquired on 5-JUN-1996 at 19:36
Reported on 5-JUN-1996 at 20:14
Box 1 (of 1)



2A6-6

Quanterra Denver Multichrom V2.1

[VOA06_1] 50 L05JUN96,14,1

49298-09 PDIL=100%

T=SA.

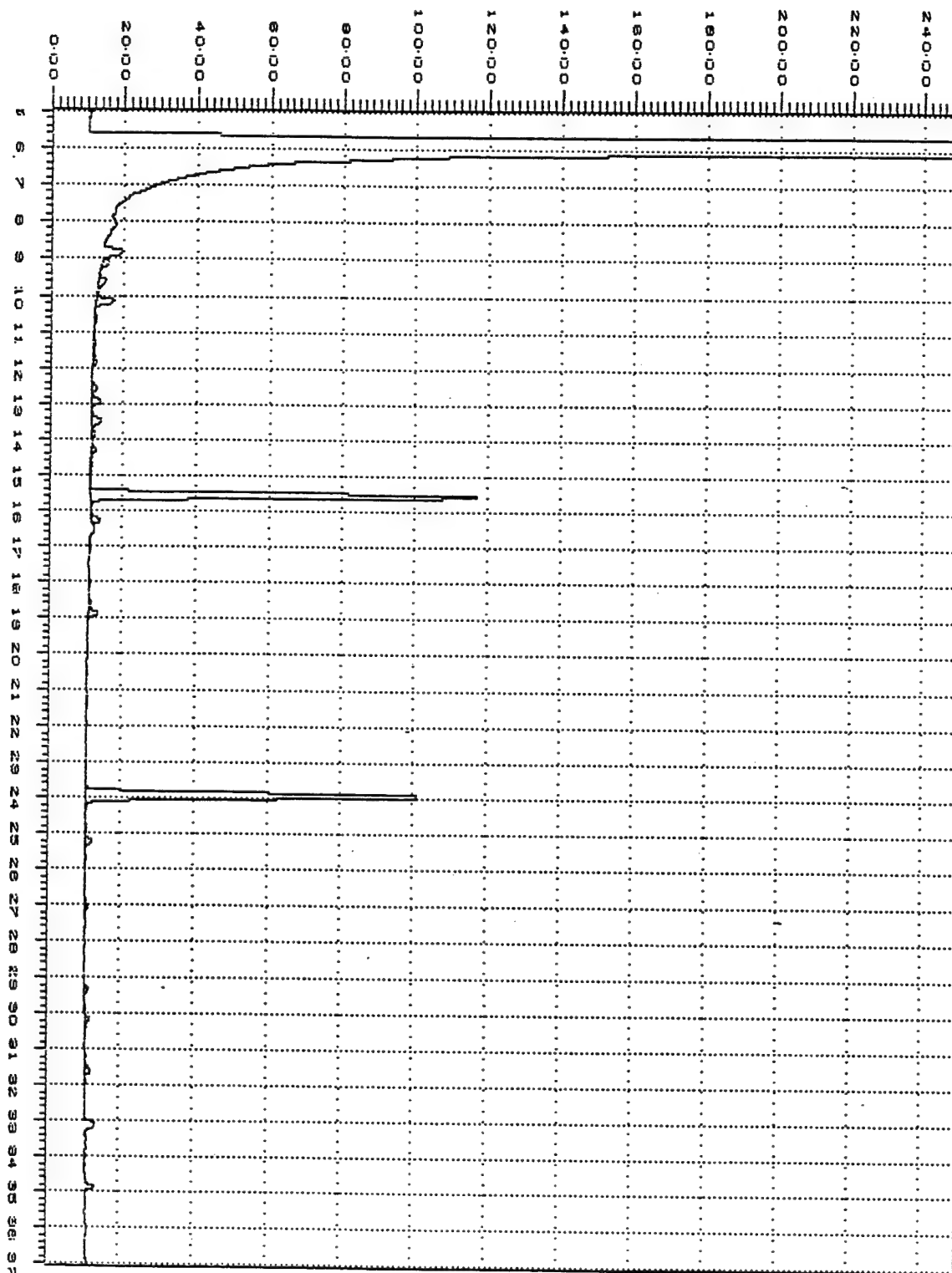
Amount : 1.000.

HP 5890 INSTRUMENT 'L' FID DETECTOR

Acquired on 5-JUN-1996 at 21:13

Reported on 5-JUN-1996 at 21:50

Box 1 (of 1)



DACT

Quanterra Denver Multichrom V2.1

[VDA06_1] 50 L05JUN96,15,1

49298-09MS PDIL=100%

T=SA.

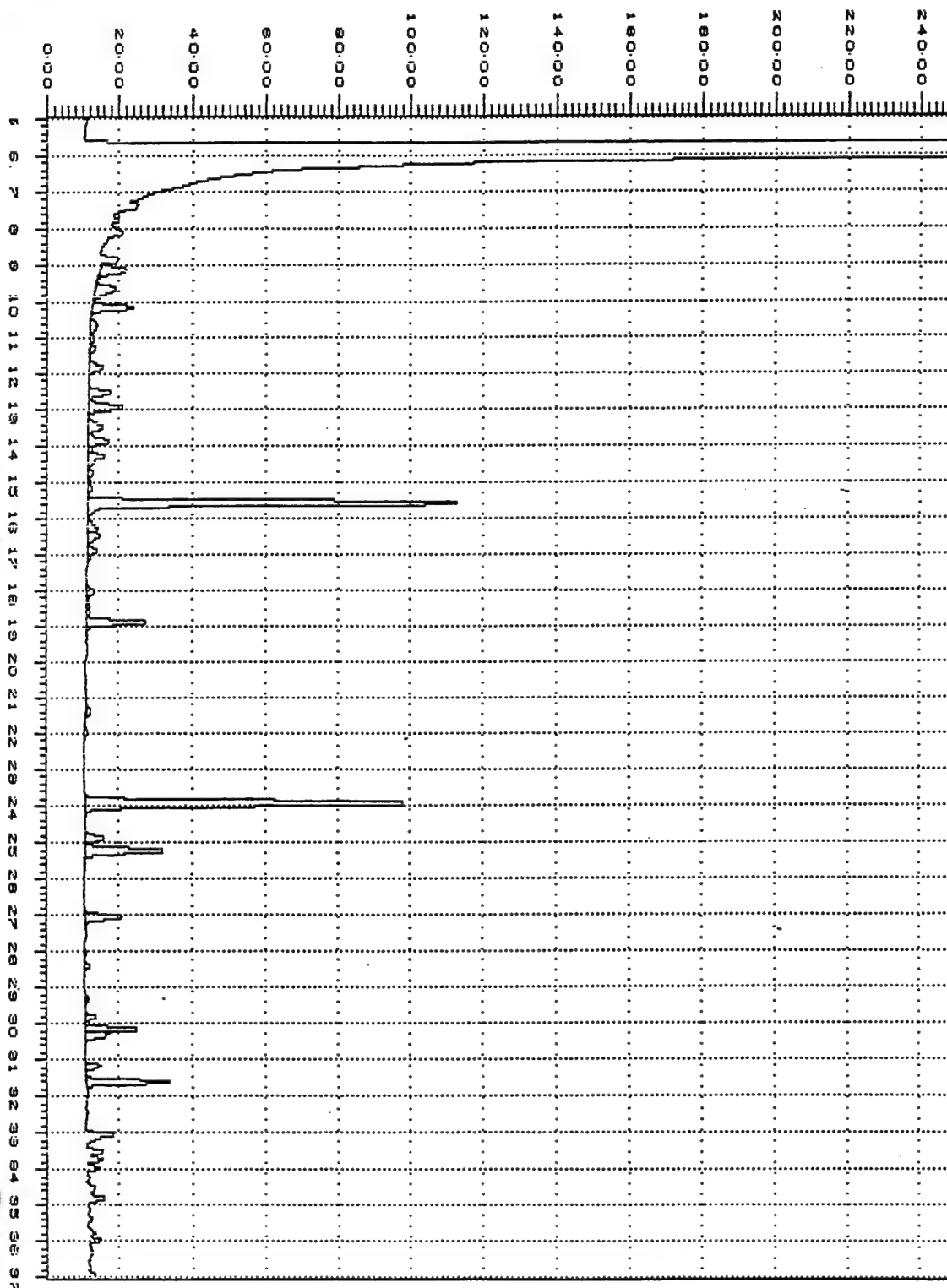
Amount : 1.000.

HF 5890 INSTRUMENT 'L' FID DETECTOR

Acquired on 5-JUN-1996 at 22:01

Reported on 5-JUN-1996 at 22:39

Box 1 (of 1)



Quanterra Denver Multichrom V2.1

[VDA06_1] 50 L05JUN96,16,1

49298-095D PDIL=100%

T=SA.

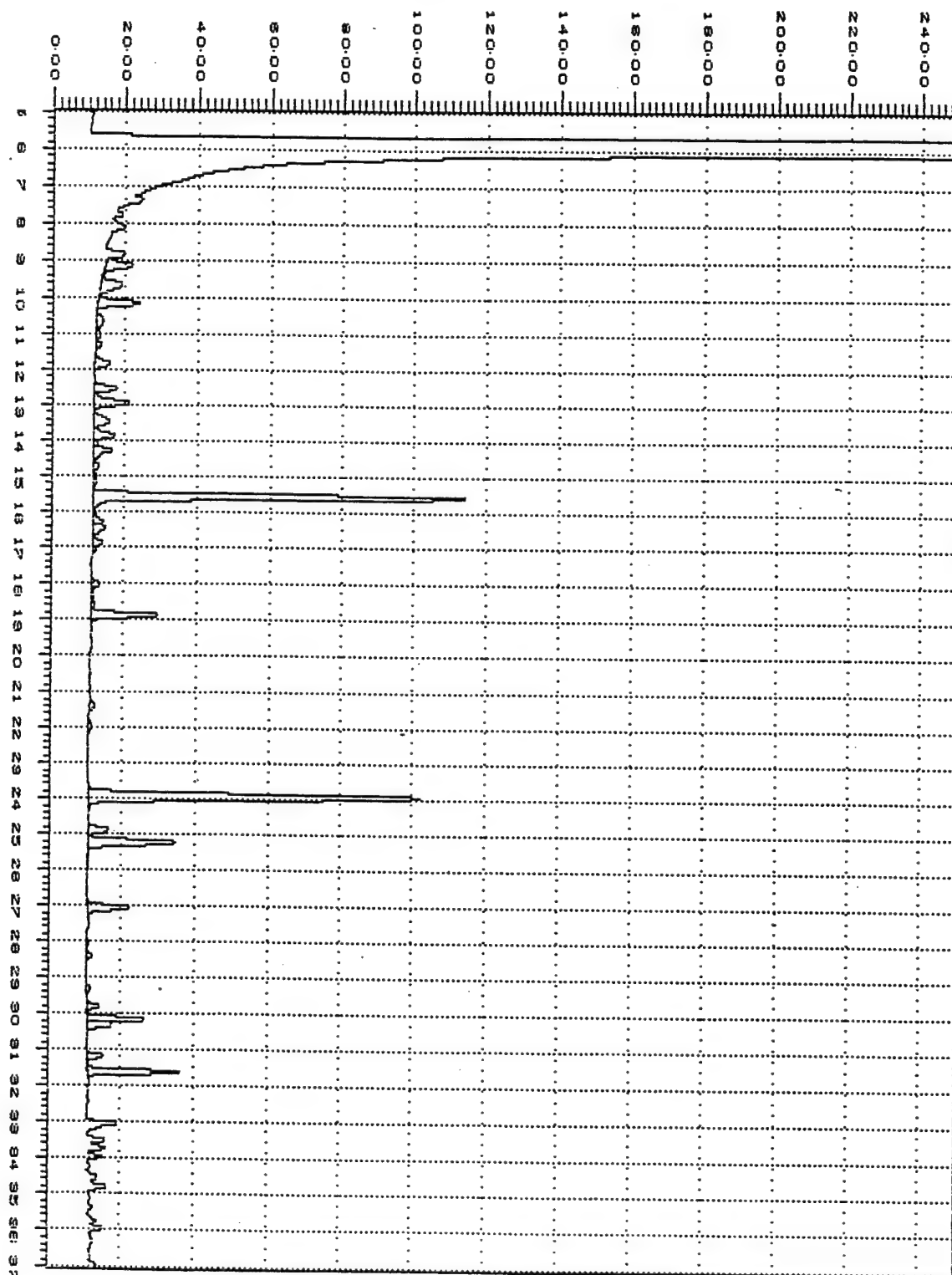
Amount : 1.000.

HP 5890 INSTRUMENT 'L' FID DETECTOR

Acquired on 5-JUN-1996 at 22:49

Reported on 5-JUN-1996 at 23:27

Box 1 (of 1)



DA-66

Quanterra Denver Multichrom V2.1

[VOA06_1] 50 L05JUN96,17,1

49298-10 PDIL=100%

T=SA.

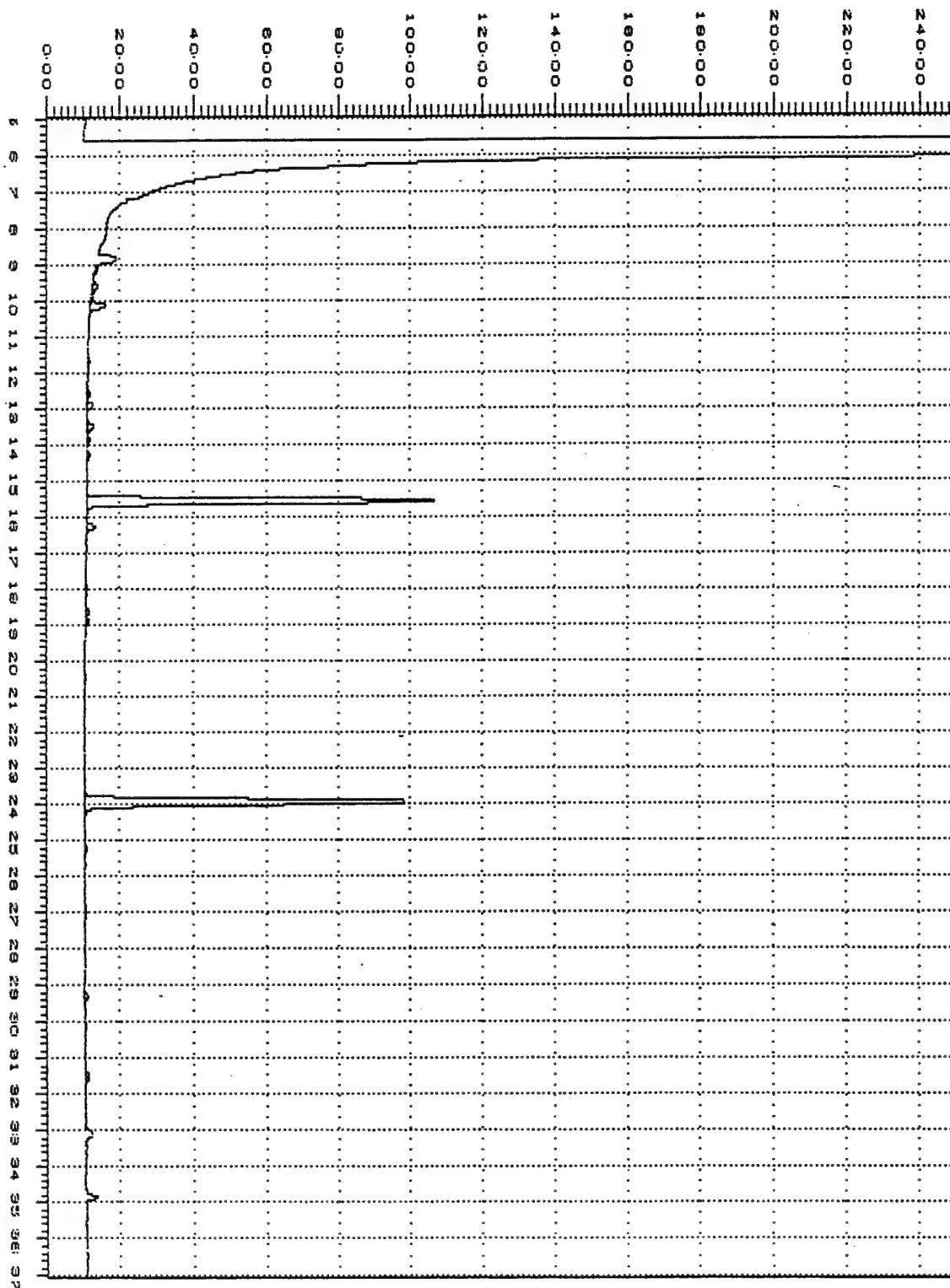
Amount : 1.000.

HP 5890 INSTRUMENT 'L' FID DETECTOR

Acquired on 5-JUN-1996 at 23:37

Reported on 6-JUN-1996 at 00:14

Box 1 (of 1)



DATA-8



QUA-4124-1

Client AFCFE Bioventing / Parsons ES, Inc.		Project Manager Dave Teets / John Ratz		Date 5/28/96		Chain Of Custody Number 75558	
Address 1700 Broadway		Telephone Number (Area Code)/Fax Number (303) 831-8100 / 831-8208		Lab Number		Page 1 of 2	
City Denver	State CO	Zip Code 80290	Site Contact Dave Teets	Lab Contact Ellen La Rina	Analysis (Attach list if more space is needed)		
Project Name Elmendorf AFB / AFCE Bioventing			Special Instructions/ Conditions of Receipt				
Contract/Purchase Order/Quote No. 726876.41122							

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix				Containers & Preservatives				Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	# Containers	
			Aqueous	Sed.	Soil	Unpres.	H2SO4	HNO3	HCl	NaOH								ZnAc/NaOH
49FB	5/28/96	0900	X															
49BH08-11.5		1025		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
49BH08-13		1045		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
49BH07-10.5		1155		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
49BH07-12		1205		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
49BH06-9.5		1355		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
49BH06-11.5		1405		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
49BH06-21.5		1425		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
49BH09-13		1500		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
49BH09-14.5		1510		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MS/msd		1500		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip Blank		1520		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Special Instructions/
Conditions of Receipt
49298 -01
-02
-03
-04
-05
-06
-07
-08
-09
-10
-9-10msd
-11-12-92

Possible Hazard Identification
☒ Non-Hazard
☐ Flammable
☐ Skin Irritant
☐ Poison B
☐ Unknown

Sample Disposal
☐ Return To Client
☒ Disposal By Lab

QC Requirements (Specify)
 1. Received By **AFCE Project**
 2. Received By **AFCE Project**
 3. Received By **AFCE Project**

Relinquished By
 1. Relinquished By **Dave Teets**
 2. Relinquished By **Dave Teets**
 3. Relinquished By **Dave Teets**

Comments

Chain of Custody Record



Quanterra
Environmental
Services

QUA-4124-1

Client

Project Manager

Date

Chain Of Custody Number

Parsons ES, Inc.

John Ratz

5/28/96

75559

Address

Telephone Number (Area Code)/Fax Number

Lab Number

1700 Broadway Ste 900

(503) 831-8100

Analysis (Attach list if more space is needed)

Page *2* of *2*

City

State

Zip Code

Site Contact

Lab Contact

Denver

CO

80003

Dave Teets

Ellen La Riviere

Project Name

Carrier/Waybill Number

Special Instructions/
Conditions of Receipt

Elmerdale AFR Closure Sampling

8188094050

TEH SW805M

44298 -12

Contract/Purchase Order/Quote No.

726876.41122

Sample I.D. No. and Description
(Containers for each sample may be combined on one line)

Date

Time

Aqueous

Sed.

Soil

Unpres.

H2SO4

HNO3

HCl

NaOH

ZnAc/NaOH

HF

Containers & Preservatives

Containers

TEH SW805M

Analysis (Attach list if more space is needed)

Special Instructions/
Conditions of Receipt

Sample I.D. No. and Description
(Containers for each sample may be combined on one line)

Date

Time

Aqueous

Sed.

Soil

Unpres.

H2SO4

HNO3

HCl

NaOH

ZnAc/NaOH

HF

Containers & Preservatives

Containers

TEH SW805M

RS

5/28/96

1440

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

Possible Hazard Identification

Sample Disposal

☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

☐ Return To Client

☐ Disposal By Lab

☐ Archive For _____ Months longer than 3 months

Turn Around Time Required

☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days

Neither Normal

Received By

Received By

Received By

Received By

Received By

Received By

Received By

Received By

1. Relinquished By

Dave Teets

5/28/96

1850

Received By

Received By

Received By

Received By

Received By

Received By

Received By

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Received By

Received By

Received By

2. Relinquished By

Dave Teets

5/28/96

1850

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3. Relinquished By

Dave Teets

5/28/96

1850

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Comments

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Received By

Sample Checklist



Project #: 49298 Date/Time Received: 5-30-96 900

Company Name & Sampling Site: Parsons - Elmerdorf

*Cooler #(s): _____

Temperatures: 2.8 _____

*Place copy of airbill inside all non-QUANTERRA coolers. Describe here.

Unpacking & Labeling Check Points:

- | Yes | No | |
|--|-------------------------------------|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 1. Radiation checked, record if reading > 0.5 mR/hr. (_____ mR/hr) |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 2. Cooler seals intact. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 3. Chain of custody present. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4. Bottles broken and/or are leaking, comment if yes. |
| <div style="border: 1px solid black; padding: 2px; display: inline-block;">PHOTOGRAPH BROKEN BOTTLES</div> | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 5. Containers labeled, comment if no. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 6. pH of all samples checked and meet requirements, note exceptions. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 7. Chain of custody includes "received by" and "relinquished" by signatures, dates, and times |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 8. Chain of custody agrees with bottle count, comment if no. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 9. Chain of custody agrees with labels, comment if no. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 10. VOA samples filled completely, comment if no. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 11. Are VOA bottles preserved, check for labels. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | 12. Sediment present in "D," dissolved, bottles. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | 13. Are analyses with short holding times requested. |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 14. Is extra sample volume provided for MS, MSD or matrix duplicates. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | 15. Multiphase samples present, comment is yes. |
| <div style="border: 1px solid black; padding: 2px; display: inline-block;">PHOTOGRAPH MULTIPHASE SAMPLES</div> | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 16. Clear picture taken, labeled, and stapled to project folder. |

Initials

Comments: Include action taken to resolve discrepancies/problems. Include a hard copy of e-mail or use extra paper if more space is needed. _____

Initials: _____

Quanterra Environmental Services, Denver
Internal Chain of Custody

Project: 049298

PAEC002 Parsons Engineering Science
Dept: Semivolatile Organics by GC
SDG: N/A Case: N/A

0002-SA Matrix: SOIL	Client ID: 49BH08-11.5
0003-SA Matrix: SOIL	Client ID: 49BH08-13
0004-SA Matrix: SOIL	Client ID: 49BH07-10.5
0005-SA Matrix: SOIL	Client ID: 49BH07-12
0006-SA Matrix: SOIL	Client ID: 49BH06-9.5
0007-SA Matrix: SOIL	Client ID: 49BH06-11.5
0008-SA Matrix: SOIL	Client ID: 49BH06-21.5
0009-MS Matrix: SOIL	Client ID: MS/MSD
0009-SA Matrix: SOIL	Client ID: 49BH09-13
0009-SD Matrix: SOIL	Client ID: MS/MSD
0010-SA Matrix: SOIL	Client ID: 49BH09-14.5
0012-RB Matrix: WATER-QA	Client ID: RB

31 MAY 96
form: SS_COC

[illegible]



005235

LABORATORY NONCONFORMANCE MEMO (NCM)

Denver Laboratory - February 23, 1995 - Revision 0

Project ID: 49298

Sample Numbers: All Samples

NCM initiated by: Matt Cravis

Project manager: Ellen LeRiviere

Analyst/Team: _____

Tests: _____

Analytical Area (check appropriate area):

- | | | | |
|--|--|--|---|
| <input type="checkbox"/> Sample control | <input checked="" type="checkbox"/> GC | <input type="checkbox"/> Wet chemistry | <input type="checkbox"/> Data review |
| <input type="checkbox"/> Organic preparation | <input type="checkbox"/> HPLC | <input type="checkbox"/> Metals | <input type="checkbox"/> Radiochemistry |
| <input type="checkbox"/> Inorganic preparation | <input type="checkbox"/> GC/MS | <input type="checkbox"/> Reporting | <input type="checkbox"/> _____ |

Nonconformance (check appropriate area):

To be completed by analyst

Holding Time Violations (exceeded by _____ days)

Category I: Laboratory Independent

- ☐ 1. Holding time expired in transit
- ☐ 2. Sample received > 48 hrs. or ½ holding time has expired
- ☐ 3. Test added by client after expiration

Category II: Laboratory Dependent

- ☐ 4. Instrument failure
- ☐ 5. Analyst error
- ☐ 6. Login error
- ☐ 7. Miscommunication
- ☐ 8. Other (explanation required)

Category III: Analysis Reruns (QA/QC)

- ☐ 9. Surrogates
- ☐ 10. Internal standards
- ☐ 11. Spike recoveries
- ☐ 12. Blank contamination

Category IV: Analysis Reruns (Confirmation)

- ☐ 13. Second column
- ☐ 14. Contamination check
- ☐ 15. Confirmation of matrix effects
- ☐ 16. Other (explanation required)

Quality Assurance/Quality Control

- ☐ 17. QC data reported outside of controls
- ☒ 18. Incorrect procedure used
- ☐ 19. SOP intentionally modified with QA and Tech. approval
- ☐ 20. Invalid instrument calibration
- ☐ 21. Received insufficient sample for proper analysis

Incorrect or Incomplete Client Deliverable

- ☐ 22. Hardcopy deliverable error
- ☐ 23. Electronic deliverable error

Reported detection limits elevated due to:

- ☐ 24. Sample matrix
- ☐ 25. Insufficient sample volume
- ☐ 26. Other (explanation required)

Not Categorized

- ☐ 27. Other (explanation required)

Explanation: TL internal chain of custody was not filled out by the GC-VOC group at all.

Notification (check appropriate area):

To be completed by project manager

Client notified by (name and date): _____

Client's name and response: _____

- ☐ In writing ☐ By facsimile
- ☐ By telephone ☐ Other (explain)

- ☐ Process "as is" ☐ Re-sample
- ☐ On hold until _____ ☐ Other (explain)

Project manager (signature and date): Ellen LeRiviere

6/19/96

Corrective Action

To be completed and reviewed by all associates involved

Root Cause

Author's initials and date: THA 06/19/96

Analyst Error. The special instructions were pulled but the section discussing the IOC was overlooked.

Corrective Action

Author's initials and date: THA 06/19/96

This NCM is the corrective action we are using for documentation purposes.

Responsibility for performing CA assigned to: _____

Actions to prevent recurrence

Author's initials and date: _____

The analysts have been reminded to ~~highlight~~ read all special instructions prior to the analysis of samples for all clients.

Group Leader/Operations Manager signature: _____

Date: 06/18/96

Project manager signature: _____

Date: 6/19/96

Quality Control/Quality Assurance Review

To be completed by a QA associate

☐ Anomaly

☐ Deficiency

☐ Further action required: _____

Further action assigned to: _____

QA/QC signature: _____

Date: _____

Long Term Corrective Action Verification

To be completed by a QA associate

☐ Verification not required or requested

Verified by: _____

Nonconformance Memo Closure

Project manager signature: _____

Date: _____

QA/QC signature: _____

Date: _____

The Office of Quality Assurance maintains a copy of this NCM indicating its final status.

APPENDIX C
LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
Project 049298 - 0001 8020-BTEX

1. Laboratory name enl, address enl telephone number enl fax number enl
QA Officer, Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14/96
% solids analysis or explanation (0 H₂O)
method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
All corrections and strikeouts initialed and dated N/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
time/date temperature measured enl sample refrigerated ☒ temperature ☒
date/time No
19. Sample transfer log/rls/chain-of-custody form enl
20. Analyst's name on all report pages on attachments with date prepared ☒
Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
client requested unbound

LABORATORY DATA REPORT (page 2 of 2)

BTEX

49298-
0001

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A, Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

APPENDIX C

LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
 Project 049298-0002

1. Laboratory name enl, address enl, telephone number enl, fax number enl
 QA Officer, Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14/96
 % solids analysis or explanation (No H₂O)
 method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
 All corrections and strikeouts initialed and dated N/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
 time/date temperature measured enl sample refrigerated ☒ temperature ☒
 date/time No
19. Sample transfer log/ris/chain-of-custody form enl
20. Analyst's name on all report pages enl with date prepared ☒
 Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
Client requested unbound

LABORATORY DATA REPORT (page 2 of 2)

BTEX

GRO

49298-
0002

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298
0002

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number UA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO Method blank NO Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96

Project 049298-0003

1. Laboratory name enl, address enl telephone number enl, fax number enl
QA Officer, Signature enl date signed enl
Designate

2. Report date enl

3. Analyte of interest, or target analyte enl

4. Extraction method # and name

5. Type of matrix enl

6. Field sample number enl

7. Lab sample number enl

8. Lab file ID number enl

9. Date sampled enl

10. Date received enl

11. Date extracted enl

12. Date analyzed enl

13. Sample collection point in client ID

14. Site or project name on COC

15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14
% solids analysis or explanation (% H₂O)
method detection limit or method reporting limit indicated enl

16. Identification of flags or qualifiers enl

All corrections and strikeouts initialed and dated N/A

17. Precision and accuracy value for each sample set enl

18. Ambient container temperature upon receipt of sample enl

time/date temperature measured enl sample refrigerated ☒ temperature ☒

date/time No

19. Sample transfer log/r/s/chain-of-custody form enl

20. Analyst's name on all report pages on chromatograms with date prepared ☒

Analyst's signature/initials on all chromatograms initials

21. Dilution factor enl

22. Case narrative summary enl

23. Report securely bound No with sequentially numbered pages enl

*client requested
unsealed*

LABORATORY DATA REPORT (page 2 of 2)

BTEX
GRO49298-
0003

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
 - Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
 - chromatograms baseline-baseline integrated N/A
 - integration report included (clearly labeled) ☒
 - integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
 - Date/time of initial calibration ☒ concentration range clearly indicated ☒
 - composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
 - Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
 - % recovery for each sample ☒ acceptable range indicated ☒
 - outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
 - components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
 - acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
 - Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298-
0003

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO, Method blank NO, Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C

LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
 Project 049298-0004

1. Laboratory name enl address enl telephone number enl fax number enl
 QA Officer Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14/96
 % solids analysis or explanation (90 H₂O)
 method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
 All corrections and strikeouts initialed and dated W/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
 time/date temperature measured enl sample refrigerated ☒ temperature ☒
 date/time No
19. Sample transfer log/rls/chain-of-custody form enl
20. Analyst's name on all report pages in data sheets with date prepared ☒
 Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
client requested unsecured

LABORATORY DATA REPORT (page 2 of 2)

BTEX
GRO49298-
0004

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

NOTE: All items listed below must be kept on file for at least three years after analysis:

49298
-0004

DRO

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO Method blank NO Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C

LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
 Project 049298-0005

1. Laboratory name enl, address enl telephone number enl, fax number enl
 QA Officer, Signature enl ^{Designate} date signed enl
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14
 % solids analysis or explanation (% H₂O)
 method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
 All corrections and strikeouts initialed and dated N/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
 time/date temperature measured enl sample refrigerated ☒ temperature ☒
 date/time No
19. Sample transfer log/r/s/chain-of-custody form enl
20. Analyst's name on all report pages on attachments with date prepared ☒
 Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
Client requested unsecured

LABORATORY DATA REPORT (page 2 of 2)

BTEX
GRO49298
-0005

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

DRO

49298
-0005

LABORATORY DATA REPORT (page 2 of 2)

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO Method blank NO Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C

LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
 Project 049298 - 0006

1. Laboratory name enl, address enl telephone number enl, fax number enl
 QA Officer, Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14/96
 % solids analysis or explanation (0.0 H₂O)
 method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
 All corrections and strikeouts initialed and dated N/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
 time/date temperature measured enl sample refrigerated ☒ temperature ☒
 date/time No
19. Sample transfer log/ris/chain-of-custody form enl
20. Analyst's name on all report pages enl with date prepared ☒
 Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
client requested unbound

LABORATORY DATA REPORT (page 2 of 2)

BTEX
GRO

49298

-0006

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All we present (there were multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298
-0006

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 Jun 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO, Method blank NO, Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C

LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96

Project 049298-0007

1. Laboratory name enl address enl telephone number enl fax number enl
 QA Officer, Signature enl date signed enl
Designate

2. Report date enl

3. Analyte of interest, or target analyte enl

4. Extraction method # and name

5. Type of matrix enl

6. Field sample number enl

7. Lab sample number enl

8. Lab file ID number enl

9. Date sampled enl

10. Date received enl

11. Date extracted enl

12. Date analyzed enl

13. Sample collection point in client ID

14. Site or project name on COC

15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14
 % solids analysis or explanation (No H₂O)
 method detection limit or method reporting limit indicated enl

16. Identification of flags or qualifiers enl

All corrections and strikeouts initialed and dated N/A

17. Precision and accuracy value for each sample set enl

18. Ambient container temperature upon receipt of sample enl

time/date temperature measured enl sample refrigerated ☒ temperature ☒

date/time No

19. Sample transfer log/rls/chain-of-custody form enl

20. Analyst's name on all report pages on data sheets with date prepared ☒

Analyst's signature/initials on all chromatograms initials

21. Dilution factor enl

22. Case narrative summary enl

23. Report securely bound No with sequentially numbered pages enl

*client requested
uninitialed*

LABORATORY DATA REPORT (page 2 of 2)

BTEV
GRO49298
-0007

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298
-0007

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO, Method blank NO, Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
Project 049298 - 0008

1. Laboratory name enl address enl telephone number enl fax number enl
QA Officer, Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14/96
% solids analysis or explanation (20 H₂O)
method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
All corrections and strikeouts initialed and dated W/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
time/date temperature measured enl sample refrigerated ☒ temperature ☒
date/time No
19. Sample transfer log/rls/chain-of-custody form enl
20. Analyst's name on all report pages enl with date prepared ☒
Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
Client requested unsecured

LABORATORY DATA REPORT (page 2 of 2)

BTEV
GRO

49298

-0008

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298
-0008

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO, Method blank NO, Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C
LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
Project 049298-0009

1. Laboratory name enl, address enl telephone number enl fax number enl
QA Officer, Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # _____ and name _____
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/1
% solids analysis or explanation (20 H₂O)
method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
All corrections and strikeouts initialed and dated N/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
time/date temperature measured enl sample refrigerated ☒ temperature ☒
date/time No
19. Sample transfer log/rls/chain-of-custody form enl
20. Analyst's name on all report pages on attachments with date prepared ☒
Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
client requested unsecured

LABORATORY DATA REPORT (page 2 of 2)

BTEV
GRO

49298

-0009

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there were multiple batches analyzed)
2. Original data package (with analyst's initials)
 Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
 chromatograms baseline-baseline integrated N/A
 integration report included (clearly labeled) ☒
 integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
 Date/time of initial calibration ☒ concentration range clearly indicated ☒
 composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
 Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
 % recovery for each sample ☒ acceptable range indicated ☒
 outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
 components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
 analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
 acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
 Reagent blank N/A, Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298
-0009

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NA
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO, Method blank NO, Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C

LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
 Project 049298 - 0009ms

1. Laboratory name enl, address enl telephone number enl, fax number enl
 QA Officer, Signature enl date signed enl
 Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14/9
 % solids analysis or explanation (No H₂O)
 method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
 All corrections and strikeouts initialed and dated W/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
 time/date temperature measured enl sample refrigerated ☒ temperature ☒
 date/time No
19. Sample transfer log/rts/chain-of-custody form enl
20. Analyst's name on all report pages on data sheets with date prepared ☒
 Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
client requested
unintended

LABORATORY DATA REPORT (page 2 of 2)

BTEY
GRD49298
-0009MS

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there were multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298
-0009ms

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO, Method blank NO, Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C
LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
Project 049298 - 000950

1. Laboratory name enl address enl telephone number enl fax number enl
QA Officer, Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/1
% solids analysis or explanation (to H₂O)
method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
All corrections and strikeouts initialed and dated N/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
time/date temperature measured enl sample refrigerated ☒ temperature ☒
date/time No
19. Sample transfer log/ris/chain-of-custody form enl
20. Analyst's name on all report pages on attachments with date prepared ☒
Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
client requested unsecured

LABORATORY DATA REPORT (page 2 of 2)

BTEX
GRO49298
-0009 SD

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298
0009SD

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO, Method blank NO, Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C
LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
Project 049298-0010

1. Laboratory name enl, address enl telephone number enl, fax number enl
QA Officer, Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/14/96
% solids analysis or explanation (20 H₂O)
method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
All corrections and strikeouts initialed and dated N/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
time/date temperature measured enl sample refrigerated ☒ temperature ☒
date/time No
19. Sample transfer log/ris/chain-of-custody form enl
20. Analyst's name on all report pages in strikeouts with date prepared ☒
Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
client requested unsealed

LABORATORY DATA REPORT (page 2 of 2)

BTEX
GRO

49298

-0010

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298
-0010

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO, Method blank NO, Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒

APPENDIX C
LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
Project 049298-0011

1. Laboratory name enl, address enl telephone number enl fax number enl
QA Officer, Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/11
% solids analysis or explanation (No H₂O)
method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
All corrections and strikeouts initialed and dated N/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
time/date temperature measured enl sample refrigerated ☒ temperature ☒
date/time No
19. Sample transfer log/rls/chain-of-custody form enl
20. Analyst's name on all report pages in data sheets with date prepared ☒
Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
client requested unsealed

LABORATORY DATA REPORT (page 2 of 2)

BTEX

49298

-0011

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number All are present (there are multiple batches analyzed)
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated N/A
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number N/A Date determined N/A
analyst's initials N/A
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank N/A Method blank ☒ Bottle blank ☒
9. Reference (library) sample included N/A Pattern match/narrative summary N/A

APPENDIX C
LABORATORY DATA REPORT (page 1 of 2)

Reviewer Ellen LaRiviere Date 7/18/96
Project 049298-0012

1. Laboratory name enl, address enl telephone number enl, fax number enl
QA Officer, Signature enl date signed enl
Designate
2. Report date enl
3. Analyte of interest, or target analyte enl
4. Extraction method # and name
5. Type of matrix enl
6. Field sample number enl
7. Lab sample number enl
8. Lab file ID number enl
9. Date sampled enl
10. Date received enl
11. Date extracted enl
12. Date analyzed enl
13. Sample collection point in client ID
14. Site or project name on COC
15. Concentration of analyte (mg/kg dry or mg/L) ug/kg (dry) and ug/L approved by Dave Teets 6/1
% solids analysis or explanation (70 H₂O)
method detection limit or method reporting limit indicated enl
16. Identification of flags or qualifiers enl
All corrections and strikeouts initialed and dated N/A
17. Precision and accuracy value for each sample set enl
18. Ambient container temperature upon receipt of sample enl
time/date temperature measured enl sample refrigerated ☒ temperature ☒
date/time No
19. Sample transfer log/ris/chain-of-custody form enl
20. Analyst's name on all report pages in data sheets with date prepared ☒
Analyst's signature/initials on all chromatograms initials
21. Dilution factor enl
22. Case narrative summary enl
23. Report securely bound No with sequentially numbered pages enl
client requested unsealed

LABORATORY DATA REPORT (page 2 of 2)

DRO

49298
-0012

NOTE: All items listed below must be kept on file for at least three years after analysis:

1. Laboratory file identification number 10 JUN 96 - 01
2. Original data package (with analyst's initials)
Sample queue ☒ chromatograms included ☒ chromatograms clearly labeled ☒
chromatograms baseline-baseline integrated ☒
integration report included (clearly labeled) ☒
integration range clearly indicated ☒ date/time on all chromatograms ☒
3. Calibration report (with analyst's initials)
Date/time of initial calibration ☒ concentration range clearly indicated ☒
composition of calibration standard(s) ☒ Lab Control Standard analyzed, date/time ☒
Continuing Calibration Standard analyzed, date/time ☒
4. Surrogate used ☒ surrogate properly identified ☒
% recovery for each sample ☒ acceptable range indicated ☒
outliers explained ☒
5. Alkane/window retention time standard analyzed ☒
components properly identified ☒
6. Column performance/separation number NA Date determined NA
analyst's initials NK
7. Spike/spike duplicate analyzed ☒ recoveries ☒ relative % difference ☒
acceptable range clearly indicated ☒ outliers explained ☒
8. Blank data (no blank correction of field samples!)
Reagent blank NO Method blank NO Bottle blank NO
9. Reference (library) sample included NO Pattern match/narrative summary ☒



APPENDIX D

LABORATORY QUALITY ASSURANCE REPORT



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LIST OF ACRONYMS

ADEC	Alaska Department of Environmental Conservation
AFB	Air Force base
BTEX	benzene, toluene, ethylbenzene, and xylenes
CCAL	continuing calibration
COC	chain of custody
CCS	contract compliance screening
DQO	data quality objective
GC	gas chromatography
ICAL	initial calibration
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
MS/MSD	matrix spike/matrix spike duplicate
MDL	method detection limit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
Parsons ES	Parsons Engineering Science, Inc.
PARCC	precision, accuracy, representativeness, comparability, and completeness
PQL	practical quantification limit
PR	percent recovery
PC	percent completeness
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
QCSR	quality control summary report
TEH	total extractable hydrocarbons
TVH	total volatile hydrocarbons
USEPA	United States Environmental Protection Agency
UST	underground storage tank

APPENDIX D
QUALITY CONTROL SUMMARY REPORT
Site ST71
Elmendorf Air Force Base, Alaska

D1.0 INTRODUCTION

This Quality Control Summary Report (QCSR) has been prepared as a quality assessment of the data collected to confirm the remediation of fuel-contaminated soil through the use of *in situ* bioventing in the vicinity of the underground storage tank (UST) at Site ST71 at Elmendorf Air Force Base (AFB), Alaska. The purpose of soil confirmation sampling was to demonstrate that fuel hydrocarbons in vadose zone soils have been remediated to concentrations below Alaska Department of Environmental Conservation (ADEC, 1995) Category A soil cleanup criteria for site closure.

This QCSR presents the results of a United States Environmental Protection Agency (USEPA) Level III validation, performed by Parsons Engineering Science, Inc. (Parsons ES), for the analytical data collected. Environmental soil samples were collected during the field work portion (May 1996) to demonstrate compliance with regulatory requirements for closure of Site ST71. The samples were collected and analyzed in accordance with the work plan (Parsons ES, 1996).

D1.1 Project Data Quality Objectives

The objective of soil confirmation sampling was to collect sufficient soil data to support closure of Site ST71. This QCSR evaluates the data collected for usability in accordance with the project data quality objectives (DQOs).

The project DQOs were designed to obtain data results that are valid, reliable, defensible, and of known precision and accuracy. Quality assurance/quality control (QA/QC) was ensured through appropriate sample collection, preservation, and transport methods, as well as through laboratory performance within project-specific analytical protocols. The work plan (Parsons ES, 1996) and the closure sampling plan describe the sampling and analysis activities undertaken at Site ST71 and the QA/QC procedures and protocols used during sample collection and analysis. Implementation of the procedures detailed in the work plan ensured that a sufficient quantity of data was collected, and that these data are valid, reliable, and defensible in a court of law for the purposes for which they were intended. The laboratory data were reviewed for compliance with the specific requirements of the protocols of the analytical methods used during the project (Section D2.4).

D1.2 Summary of Overall Data Quality

The data generated from the soil confirmation sampling at Site ST71 met all project DQOs. Analytical methods are specified in Section D2.4. All sample results were validated in accordance with the criteria presented in Section D2.2. The results of the review of data QC parameters, as specified in the analytical methods, can be summarized as follow:

- All analytical method-specific holding times were met.
- Field blank and laboratory method blank contamination typically was reported at concentrations representative of normal laboratory procedures, and sample data quality was not adversely affected due to blank contamination.
- Practical quantitation limits (PQLs) as defined in the Table D1.1 (Attachment D1) were met on a regular basis except for benzene. A more detailed discussion is found in Section D3.3.
- Initial calibration (ICAL) and continuing calibration (CCAL) criteria were met.
- Accuracy and precision data from the results of matrix spike/matrix spike duplicates (MS/MSDs), field duplicates and laboratory control sample/laboratory control sample duplicates (LCS/LCSDs) were acceptable for all methods. Surrogate spike accuracy was exceeded for a,a,a-trifluorotoluene (USEPA Method SW8020A) in two soil samples. Results for all affected compounds were qualified as estimated.
- Data were 100-percent complete, thereby exceeding the project completeness goal of 90 percent.

Overall, DQOs were met for precision, accuracy, representativeness, comparability and completeness (PARCC). These QA parameters are discussed in detail in Sections D4.0 through D8.0.

D2.0 DATA REVIEW PROCESS

The data review process was performed in two phases. The initial phase, contract compliance screening (CCS), consisted of inspecting the laboratory data deliverables to determine if the contract requirements were met. The second phase, data validation, included a review of data results to assess data usability and application of data qualifiers to the analytical results based on adherence to method protocols and laboratory-specific QA/QC limits (Level III review).

D2.1 Contract Compliance Screening

CCS involved the review of sample data deliverables for completeness and compliance with project requirements. Completeness was evaluated by ensuring that all required data deliverables were received in a legible format with all required information. Data deliverables consisted of summary information only. The CCS

process also included review of the chain of custody (COC) forms, case narratives, and PQLs. Sample resubmission requests, documentation of nonconformances with respect to data deliverable completeness, and corrective actions if required, would be initiated during the CCS review.

D2.2 Data Validation

Following completion of the CCS process, a validation of all analytical results was performed. All data were to be subject to USEPA Level III validation to meet the project requirements (Parsons ES, 1996). The Level III validation process included a review of summary information to determine adherence to analytical holding times; results from analysis of field replicates (borehole 49BH06 at 11.5 feet and 49BH06 at 21.5 feet), method blanks, field blanks, surrogate spikes, laboratory duplicates, MS/MSDs (borehole 49BH09 at 12.5 feet), and LCS/LCSDs; and evaluation of ICALs, CCALs, and second-column confirmations. The results of the CCS process were incorporated into the data validation process. Data qualifiers were applied to analytical results during the data validation process, based on adherence to method protocols, ADEC quality assurance/quality control (QA/QC) limits, and using guidelines defined in Table D1.2 (Attachment D1), as applicable to each method. The validation guidelines defined in Table D1.2 were developed in accordance with the *National Functional Guidelines for Organic Data Review* (USEPA, 1994). Expanded criteria for the validation guidelines were developed where professional judgment is recommended within the USEPA guidelines. The results of the data validation for all validated project samples are described in Section D3.0

D2.3 Data Reporting Qualifiers

The following definitions provide explanations of the USEPA (1994) qualifiers assigned to analytical results during data validation, in accordance with Table D1.2.

Data Validation Qualifiers

- U - The analyte was analyzed for and is not present above the reported sample quantitation limit.
- J - The analyte was analyzed for and was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environmental sample.
- R - The data are rejected as unusable for all purposes. The analyte was analyzed for, but the presence or absence of the analyte was not verified. Resampling and reanalysis are necessary to confirm the presence or absence of the analyte.
- UJ - The analyte analyzed for was not present above the reported sample quantitation limit. The associated numerical value may not accurately or precisely represent the concentration necessary to detect the analyte in the sample.

D2.4 Laboratory Analytical Procedures

Application of a specific analytical method depends on the sample matrix and the analytes to be identified. The contract laboratory that performed the Site ST71 soil confirmation sample analyses was Quanterra Environmental Services in Arvada, Colorado. All analytical methods used were USEPA-approved. The analytical methods performed by Quanterra were as follow:

- SW8020A • Volatile aromatic compounds benzene, toluene, ethylbenzene, and xylenes (BTEX) by gas chromatography (GC);
- SW8015A • Total volatile hydrocarbons (TVH), referenced to
Modified gasoline, by GC; and
- SW8015A • Total extractable hydrocarbons (TEH), referenced to
Modified diesel fuel by GC.

Analytical methods used were based on methods developed and described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, Update IIB (USEPA, 1995).

D2.5 Sample Collection

All sample collection and handling procedures are described in Section 4 of the work plan (Parsons ES, 1996). Table D1.3 (Attachment D1) lists analytical holding times, sample containers, and preservation requirements for the methods used.

D3.0 DATA QUALITY

The data quality summaries for each QC parameter for which exceptions were noted during the Level III review are presented below. In these summaries, only results that exceeded QA/QC criteria are discussed. Table D1.4, lists all data qualified during the Level III validation process. All samples collected were validated. The following QC criteria were in control for all samples reviewed, therefore qualification was not required:

- Shipping cooler temperatures,
- Case narrative reviews,
- Holding times,
- Field blanks,
- MS/MSDs,
- LCS/LCSDs,
- Initial and continuing calibrations

- Second-column confirmations, and
- Field replicates.

All sample analyses adhered to method protocols. All frequency requirements specified in the work plan (Parsons ES, 1996) for MS/MSDs, field duplicates, and field blanks were met. QC criteria exceedances, and the resulting impacts on data quality, for other parameters are described in the following subsections.

D3.1 Method Blank Criteria Exceedances

The method blank associated with USEPA Method SW8020A water QC samples contained a low level concentration of toluene. Two water samples (49FB and TRIP BLANK) contained concentrations comparable to the method blank. The results for toluene in the affected samples were qualified as nondetect, per Table D1.2 (Attachment D1). All qualified data are listed in Table D1.4.

D3.2 Surrogate Spike Criteria Exceedances

Sample 049BH07-12 required qualification of BTEX for exceeding the surrogate spiking criterion. Sample 049BH06-21.5 required qualification of xylenes for exceeding the surrogate spiking criterion. These compounds were qualified as estimated in their associated samples (see Table D1.4). Qualified sample data are believed to result from matrix-related interferences.

D3.3 PQLs

Benzene was reported at 0.005 milligram per kilogram (mg/kg), which was above the required PQL of 0.001 mg/kg (Table D1.1). However, the laboratory evaluated results of detections of benzene concentrations between their method detection limit (MDL) of 0.001 mg/kg and 0.005 mg/kg (PQL). Samples result with concentrations between the MDL and PQL were reported as estimated by the laboratory. Because sample results were reported to 0.001 mg/kg, the data are not adversely affected.

D4.0 PRECISION

Precision is the measure of variability among individual sample measurements under prescribed conditions. The relative percent differences (RPDs) for field replicates, MS/MSDs, LCS/LCSDs, and laboratory duplicates analyses demonstrate the precision of the analytical methods. An RPD within the method-specific control limit indicates satisfactory precision in a measurement system. Methods were considered out of control when greater than 25 percent of all precision data were exceeded (see Table D1.5).

All precision indicators were in control, and therefore overall method precision was judged to be acceptable. A summary of precision data review results is presented in Table D1.6 (Attachment D1).

D5.0 ACCURACY

Accuracy is the degree of agreement of a measurement to an accepted reference or true value. The results of surrogate, MS/MSD, and LCS/LCSD analyses, when expressed in terms of percent recovery (PR), demonstrate the accuracy of the method. Surrogate and MS/MSD spike PRs indicate accuracy relevant to a unique sample matrix. LCS/LCSD spike PRs indicate accuracy relevant to an analytical batch lot, and are strictly a measure of laboratory analytical accuracy conditions independent of samples and matrices. Methods were considered out of control when greater than 25 percent of all accuracy data were exceeded (see Table D1.5).

The out-of-control surrogate accuracy results for Method SW8020A (see Section D3.2) were judged to have a nominal effect on data quality. In general, all other accuracy data were in control; therefore, overall method accuracy was acceptable. A summary of accuracy data results is presented in Table D1.6.

D6.0 REPRESENTATIVENESS

Sample data are believed to be representative of the former UST source area conditions prevailing at Site ST71 at the time of sample collection because all samples were properly collected, stored, and preserved. Holding times were met for all samples. All PQLs (Table D1.1) were met except for benzene as discussed in Section D3.3. The laboratory method blank contamination was reported at concentrations representative of normal laboratory procedures, and sample data quality was not adversely affected due to blank contamination.

D7.0 COMPARABILITY

All samples were reported in industry-standard units. The water reporting units were micrograms per liter ($\mu\text{g/L}$) and soil reporting units were mg/kg . All soil analyses were reported on a dry-weight basis. Protocols for the analytical methods listed in Section D2.4 are considered comparable.

D8.0 COMPLETENESS

Completeness is defined as the percentage of measurements (analytical results) judged to be valid on a method-by-method basis. Valid data were defined as all data (including data qualified as estimated) considered to meet the DQOs for this project. Data completeness is expressed as percent complete (PC), and must be 90 percent or better. The goal for meeting analytical holding times is 100 percent. The holding time completeness goal was accomplished. Total project completeness was 100 percent for all methods and matrices (Table D1.6).

D9.0 REFERENCES

Parsons Engineering Science, Inc. (Parsons ES). 1996. *Closure Sampling and Analysis Plan For Site ST71, Elmendorf Air Force Base, Alaska.*

US Environmental Protection Agency (USEPA). 1995. *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods*, SW-846, Third Edition, Update IIB. Washington, DC.

USEPA. 1994. *National Functional Guidelines for Organic Data Review*. PB 94-963502. Washington, DC.



ATTACHMENT D1

**QUALITY CONTROL PARAMETERS, ANALYTICAL METHODS,
AND DATA VALIDATION RESULTS**



TABLE D1.1
PRACTICAL QUANTITATION LIMITS
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

Analytical Method ^{a/}	PQL (mg/kg) ^{b/}
SW8015A Modified - Total Volatile Hydrocarbons (TVH) Gasoline	1.0
SW8015A Modified - Total Extractable Hydrocarbons (TEH) Diesel Fuel	10.0
SW8020A - Volatile Aromatic Compounds	
Benzene	0.001
Toluene	0.005
Ethylbenzene	0.005
Xylenes	0.05

a/ All handling procedures are in accordance with the following reference: *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods*, Third Edition, Update IIB (USEPA, 1995).

b/ milligrams per kilogram.



LE D1.2
FLAGGING CONVENTIONS FOR DATA EVALUATION AND VALIDATION OF ORGANIC METHODS
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

Quality Control Check	Evaluation	Flag	Samples Affected
Holding Time	Holding time exceeded for extraction or analysis by > 2 times	J positive results R non-detects	Sample, MS/MSD
	Holding time exceeded for extraction or analyses by < 2 times	J positive results UJ non-detects	Sample, MS/MSD
Sample Preservation	Sample not preserved	J positive results UJ non-detects	Sample, MS/MSD
Temperature Blank	> 8°C	J positive results UJ non-detects	All samples in same cooler
	> 20°C (Volatile Compounds)	R all results.	All samples in same cooler
Initial Calibration (ICAL)	For multi-component target compounds, at least 3 peaks used with a RT window of ± 0.07 minutes each	J positive results UJ non-detects	Compound in all associated samples in analysis batch
	%RSD linearity: > 20% If % RSD > 2X control criteria	J positive results UJ non-detects R positive results and non-detects	Compound in all associated samples in analysis batch Compound in all associated samples in analysis batch
Continuing Calibration (CCAL)	%D > 15%	J positive results UJ non-detects	Compound in all associated samples in analysis batch
	If %D is > 2X control criteria	R all positive results and non-detects	Compound in all associated samples in analysis batch

TABLE D1.2 (Continued)
FLAGGING CONVENTIONS FOR DATA EVALUATION AND VALIDATION OF ORGANIC METHODS^{a/}
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

Quality Control Check	Evaluation	Flag	Samples Affected
Laboratory Control Sample (LCS) and Laboratory Control Sample Duplicate (LCSD)	LCS or LCSD single compound: %R < 30 %	R all positive results and non-detects	Spiked compound only in all associated samples.
	%R > UCL but < 150 %.	J positive results No qualification for non-detects	Spiked compound only in all associated samples.
	% R ≥ 30 % but < LCL	J positive results UJ non-detects	Spiked compound only in all associated samples.
	% R > UCL and > 150 %	R all positive results and non-detects	Spiked compound only in all associated samples.
	If ≥ 50 % of all LCS or LCSD spiked compounds are out of control: RPD > control limit	R all positive results and non-detects	All detected spike compounds in all samples
Method Blank	Multiply value by 5	J positive results U flag reported results < calculated value	All detected spike compounds in all samples All samples in extraction batch
Trip Blank	Convert to soil units, if applicable, multiply by 5, common lab contaminants ^{b/} multiply by 10	U flag reported results < calculated value	All volatile samples shipped in the same cooler
Equipment Blank	Convert to soil units, if applicable, multiply by 5, common lab contaminants multiply by 10	U flag reported results < calculated value	All samples, same field team, matrix and date (water) or all samples, same field team, matrix (soil)

TABLE 1. (Continued)
FLAGGING CONVENTIONS FOR DATA EVALUATION AND VALIDATION OF ORGANIC METHODS
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

Quality Control Check	Evaluation	Flag	Samples Affected
Matrix Spike/Matrix Spike Duplicates (MS/MSD)	MS or MSD single compound: %R < 10%	R all positive results and non-detects	Affected compound in native sample MS/MSD
	%R > UCL but < 200%	J positive results No qualification for non-detects	Affected compound in native sample MS/MSD
	%R ≥ 10% but < LCL	J positive results UJ non-detects	Affected compound in native sample MS/MSD
	%R > UCL and > 200%	R all positive results and non-detects	All compounds in native sample
	If ≥ 50% of all MS or MSD spiked compounds are out of control: When sample conc. is > 4X spike conc. RPD > control limit	R all positive results and non-detects No evaluation required J positive results No qualification for non-detects	All compounds in native sample None Affected compound in native sample MS/MSD
Surrogates	%R > UCL	J positive results	All compounds in associated sample
	%R < LCL and > 10%	J positive results UJ non-detects	All compounds in associated sample
	%R < 10%	J positive results R non-detects	All compounds in associated sample
Retention Time Windows (RTW)	Analyte peak not within RTW	Report positive result as non-detect	All affected compounds

TABLE D1.2 (Continued)
 FLAGGING CONVENTIONS FOR DATA EVALUATION AND VALIDATION OF ORGANIC METHODS^{a/}
 SITE ST71
 ELMENDORF AIR FORCE BASE, ALASKA

Quality Control Check	Evaluation	Flag	Samples Affected
Second-Column Confirmation	Primary and confirmation results do not agree within a factor of 10.	J positive results	All affected compounds

a/ Methods include: SW8020A and SW8015A Modified.

b/ Common lab contaminants include: acetone, methylene chloride, and phthalates

LCL = Lower control limit.
 UCL = Upper control limit.
 RPD = Relative percent difference.
 %D = Percent difference.
 %R = Percent recovery.
 ICV = Initial calibration verification.
 CCV = Continuing calibration verification.

SECTION D1.3
SAMPLE CONTAINERS, SAMPLE PRESERVATION METHODS, AND
HOLDING TIMES FOR SOIL
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

Analytical Parameter	Analytical Method	Sample Containers		Preservation Method (Chill at 4°C)	Holding Time
		Quantity	Type		
Total Volatile Hydrocarbons (TVH) (Gasoline)	SW8015A Mod ^{b/}	1	4 oz wide mouth with Teflon-lined cap or brass tube	4°C	14 days
Total Extractable Hydrocarbons (TEH) (Diesel Fuel)	SW8015A Mod ^{b/}	1	4 oz wide mouth with Teflon-lined cap or brass tube	4°C	14 days
Volatile Aromatic Compounds (BTEx)	SW8020A	1	4 oz glass jar with Teflon-lined cap or brass tube	4°C minimize headspace	14 days

- ^{a/} All handling procedures are in accordance with the following reference: *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods*, Third Edition, Update IIB (USEPA, 1995).
- ^{b/} The TEH method is USEPA Method SW3550/SW8015 modified for diesel fuel. The TVH method is USEPA Method SW5030/SW8015 modified for gasoline.

TABLE D1.4
ANALYTICAL RESULT QUALIFICATIONS
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

Method ^{a/}	SDG Number	Matrix	Analyte	Field Identification	Laboratory Sample Identification	Flag	Reason Code ^{b/}
SW8020A	049298	Water	Toluene	49FB	049298-0001-FB	U	A
SW8020A	049298	Water	Toluene	TRIP BLANK	049298-0011-TB	U	A
SW8020A	049298	Soil	Benzene	49BH07-12	049298-0005-SA	UJ	B
SW8020A	049298	Soil	Toluene	49BH07-12	049298-0005-SA	UJ	B
SW8020A	049298	Soil	Ethylbenzene	49BH07-12	049298-0005-SA	UJ	B
SW8020A	049298	Soil	Xylenes (Total)	49BH07-12	049298-0005-SA	J	B
SW8020A	049298	Soil	Xylenes (Total)	49BH06-21.5	049298-0008-SA	J	B

a/ All methods are from *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods*, Third Edition, Update IIB (USEPA, 1996).

b/ Reason Code:

A -Method blank criteria were not met.

B - Surrogate spike criteria were not met.

T-1 D1.5
CONTROL LIMITS FOR LABORATORY CONTROL SPIKES/LABORATORY CONTR
SPIKE DUPLICATES AND MATRIX SPIKE/MATRIX SPIKE DUPLICATES
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

Analytical	Spiking	Established Control Limit	
		Recovery range (%) ^{a/}	Relative % Difference
Method	Compound	Soil	Soil
SW8020A - Volatile Aromatic Compounds			
	Benzene	39-150	<25 ^{b/}
	Toluene	46-148	<25
	Ethylbenzene	32-160	<25
	Xylene (Total)	65-135	<25
Surrogate Spike	a,a,a-Trifluorotoluene	20-160	NA ^{c/}
SW8015A Mod - Total Extractable Hydrocarbons (TEH)			
	Diesel	48-138	<32
Surrogate Spike	a,a,a-Trifluorotoluene	64-136	NA
SW8015A Mod - Total Volatile Hydrocarbons (TVH)			
	Gasoline	65-111	<10
Surrogate Spike	a,a,a-Trifluorotoluene	75-125	NA

a/ % = percent

b/ < = less than

c/ NA = Not Applicable

TABLE D1.6
ACCURACY, PRECISION, AND COMPLETENESS
DATA SUMMARY RESULTS
SITE ST71
ELMENDORF AIR FORCE BASE, ALASKA

ACCURACY				
Method	MS/MSD ^{a/} (%)	LCS/LCSD ^{a/} (%)	Surrogate ^{a/} (%)	
Volatile Aromatic Compounds (SW8020A)	100	100	82	
Total Volatile Hydrocarbons (TVH)- Gasoline (SW8015A Mod.)	100	100	100	
Total Extractable Hydrocarbons (TEH)- Diesel Fuel (SW8015A Mod.)	100	100	100	
PRECISION				
Method	MS/MSD ^{b/} (%)	LCS/LCSD ^{b/} (%)	Field Duplicates ^{b/} (%)	
Volatile Aromatic Compounds (SW8020A)	100	100	100	
Total Volatile Hydrocarbons (TVH)- Gasoline (SW8015A Mod.)	100	100	100	
Total Extractable Hydrocarbons (TEH)- Diesel Fuel (SW8015A Mod.)	100	100	100	
COMPLETENESS				
Analysis	Method	Total Analyses	Rejected Analyses	Percent Completeness
Volatile Aromatic Compounds	SW8020A	9	0	100
Total Volatile Hydrocarbons (TVH)- Gasoline	SW8015A Mod.	9	0	100
Total Extractable Hydrocarbons (TEH)- Diesel Fuel	SW8015A Mod.	9	0	100
^{a/} Percent of all accuracy values that were within the required range				

^{a/} Percent of all accuracy values that were within the required control limit.
^{b/} Percent of all precision values that were within the required control limits